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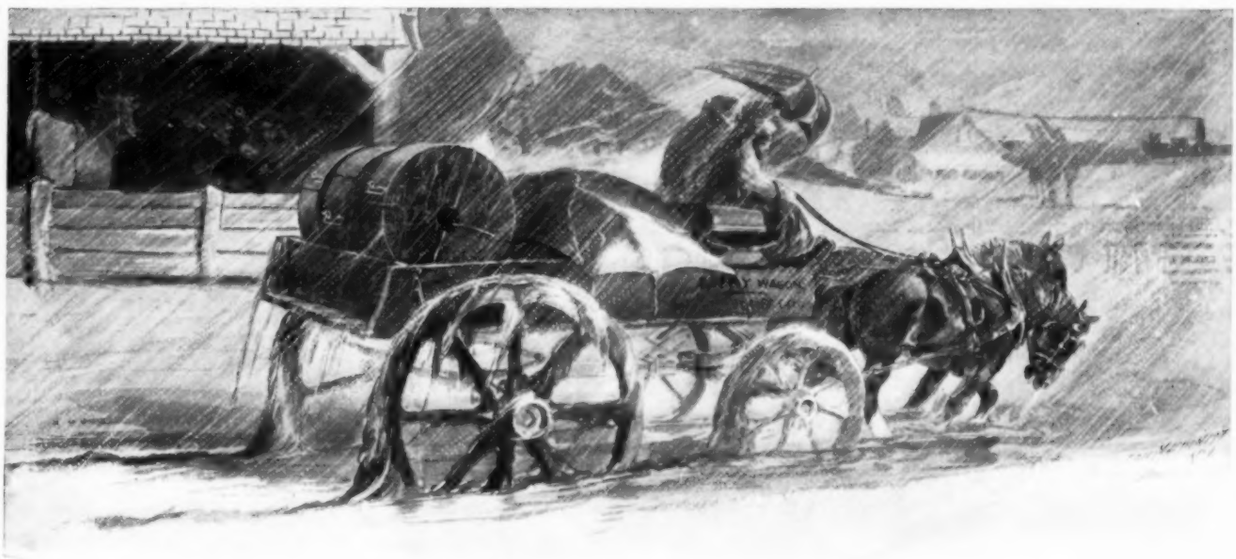

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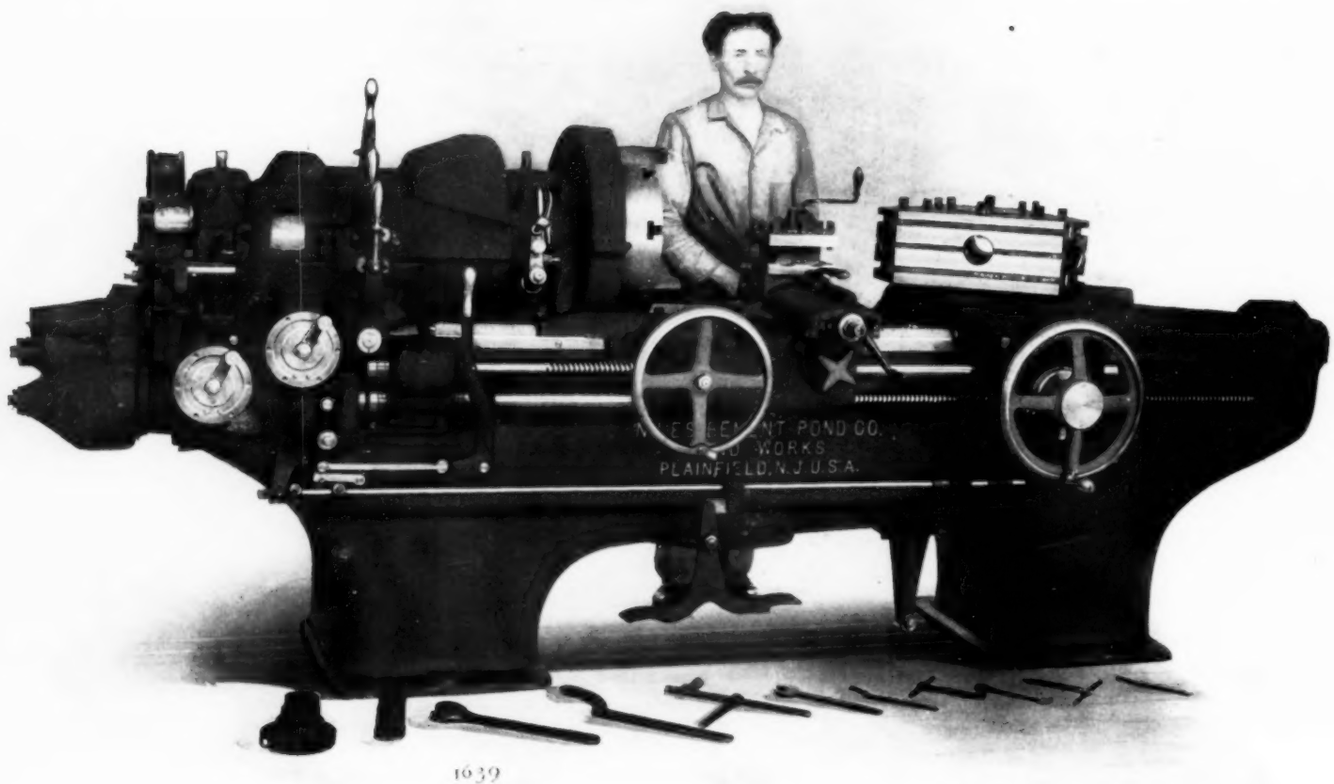

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AUTOMATIC TURRET MACHINE BUILDING

Some Methods and Tools for Manufacturing That Insure Accurate Results

BY F. A. STANLEY

There are so many interesting processes and tools employed in the manufacture of the multiple-spindle automatic turret machine built by George G. Prentice & Co., Inc., New Haven, Conn., that it is impossible within the limits of this article to cover the shop methods of the company in detail; however, quite a number of the more important of the methods involved in the machining and testing of the machine bed, head, spindle bearings, etc., are illustrated by the accompanying halftone and line engravings.

Two views of the machine itself are presented in Fig. 1, where various parts are designated by reference letters on the halftones and by name under the engraving. The machine selected for purposes of illustration is a four-spindle single-head automatic, with a chuck having five sections, the extra section permitting finished work to be removed and a new piece placed in that chuck section which is uppermost before the next indexing movement carries the work into position opposite the first tool spindle. As most readers are aware, this type of machine is also made with three- and with five-tool spindles, and with a faceplate in place of the chuck, which is used for second-operation work, say in finishing the inner ends of pieces previously handled in the chuck; and a double-head machine is built also, with two heads and two sets of spindles operating simultaneously at both sides of the chuck, this double-head design being constructed with six and with eight spindles.

Planing and Boring Operations

The beds for the machines are first rough planed on top, turned over, rough and finish planed on the bottom, turned back again and finished on top. They are then ready for the boring out of the bearing for the turret barrel upon which is carried the indexing chuck for holding the work; and for boring for the cam shaft and spindle bearings.

Some special multiple-spindle boring machines constructed for this work are illustrated in Figs. 2 and 3. Upon these machines what are called the center holes, that is, those for the cam shaft and turret barrel are roughed out and finished, the two cuts being taken with single-end boring tools. Also on these machines the holes for the spindles and back-gear shafts are roughed out. The location of these bearings, as well as the general proportions of bed and head will be noted in Fig. 4. As will be seen upon examination of the engravings, Figs. 2 and 3, the boring bars are driven by a series of spindles mounted in the head of the machine and are supported so as to resist deflection during the cut and to maintain proper alinement by fixtures placed upon the bed of the boring machine. The bars are guided entirely by the fixtures, the connection with the spindle being by means of a floating driver. The spindles are geared and driven from a shaft carrying the large belt pulley and the sliding head in which they are carried is traversed along its guide in the bed to feed the boring bars and cutters through the work by means of rack and pinion under the head, the pinion shaft being actuated by worm wheel and worm at the back, and the worm shaft deriving its movement from a belt leading off from a pulley on the lower driving shaft at the end of the machine.

While it is entirely feasible to operate simultaneously six boring bars with each of these machines, in actual practice four bars is the maximum number usually employed at one time.

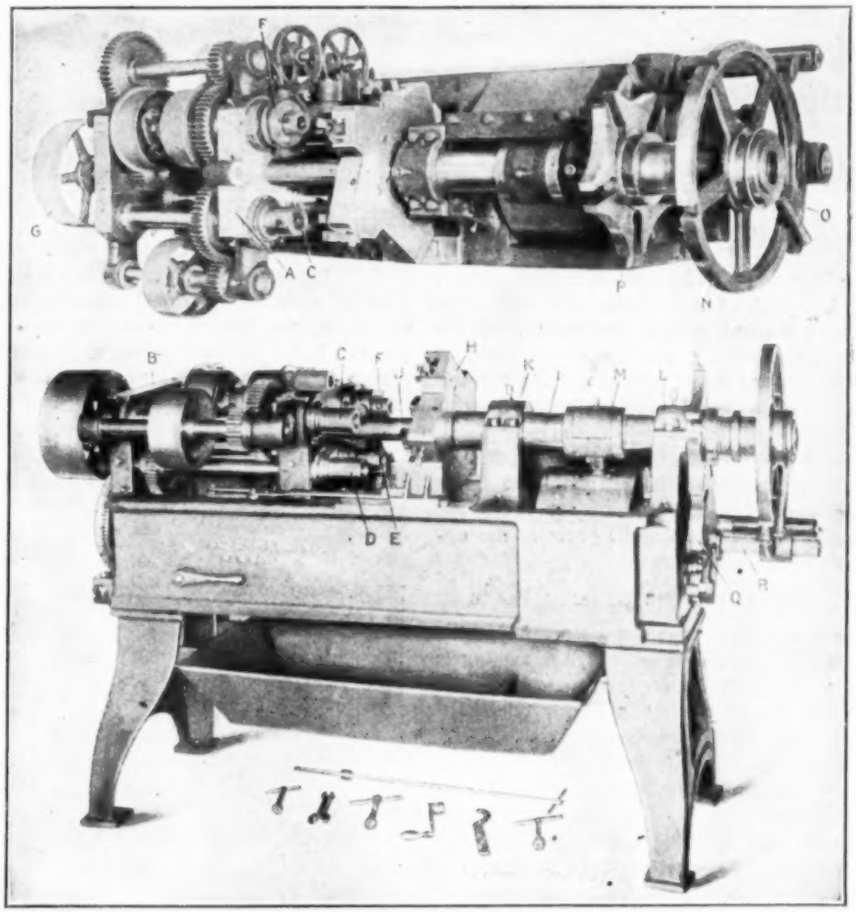


Fig. 1. The Prentice Multiple-spindle Automatic Turret Machine

A, spindle head (front).	*G*, driving pulley.	*M*, turret yoke.
B, spindle head (rear).	*H*, chuck.	*N*, index wheel.
C, first spindle.	*I*, turret barrel.	*O*, index lever.
D, second spindle.	*J*, turret shaft.	*P*, star wheel.
E, third spindle.	*K*, turret bearing (front).	*Q*, star pinion.
F, fourth spindle.	*L*, turret bearing (rear).	*R*, cam shaft.

Another Special Boring Machine

Upon leaving the multiple-spindle machine the bed is removed to the machine shown in Fig. 5, which is another home-arranged tool consisting of a radial drill placed on its side and now operated as a single-spindle, horizontal boring machine. Here the lower two holes for the spindle bearings just referred to are roughed with a single-end cutter in a bar supported in fixtures placed, as indicated, at the ends of the bed.

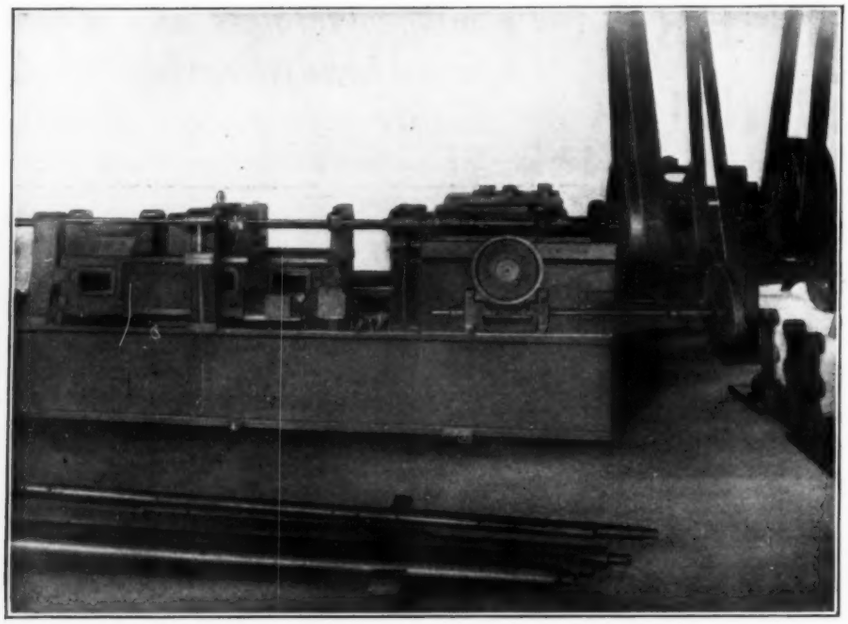


FIG. 2. MULTIPLE-SPINDLE HORIZONTAL BORING MACHINE

This converted machine is mounted on a bed plate of sufficient size to receive the large turret-machine beds and is easily manipulated by the operator. Several other holes in addition to those for the spindle bearings are put through with the aid of this machine, among these being the one for the worm bracket at the head end of the bed, and the holes for receiving the support for the index rocker and certain other parts at the opposite end of the bed.

ALINING ON THE SURFACE PLATE

Now, with the holes or seats for the spindle boxes roughed out, the casting is placed on a large surface plate, a master turret barrel or spindle is placed in the bearings later to be occupied by the regular turret barrel and these bearings are scraped for accurate alinement with the cam-shaft holes. First, plugs are placed in the cam-shaft holes and then, by means of a surface gage carrying a test indicator at the upper end of the arm, the turret-machine bed is adjusted until these plugs are parallel to the front edge of the surface plate and at equal hight above its face. The surface gage is planed at the bottom to form a ledge which is kept in contact with the front edge of the surface plate during the setting operation, so that it is a simple matter to bring the work parallel with this edge. To level it or adjust it so that the test plugs are parallel with the upper surface of the plate upon which the work rests, the bed is set up with thin wedges. It should be stated here that the bed takes a three-point bearing upon its supports, whether in the boring machine, upon the testing plate, or finally upon its own legs. This brings two points under the spindle head and the single or third point of bearing under the indexing end.

With the work set with its test plugs parallel with the surface plate, the two large bearings for the turret barrel are scraped until the master barrel or shaft placed therein, when indicated with the surface-gage appliance as in Fig. 6, is also parallel with the surface-plate edge and with the upper face of the plate. This, then, indicates that these bearings are parallel with the cam-shaft bearings below.

TURRET-SHAFT HOLES

Prior to reboring to size for the spindle bearings, the hole through the head which receives the end of the shaft passing through the turret barrel is finish bored. A test plug is placed in the mouth of the turret barrel and two similar plugs of exactly the same diameter are slipped into the holes for the turret bar in the front and rear ends of the head. The surface gage with its test indicator is then applied to the work to see that these holes are bored dead in line, the indicator, of course, locating in all these tests from the edge of the big surface plate, as represented in Fig. 6. If it is found that the holes are in line the test plugs are removed, a boring bar is placed in the turret barrel, its outer end being supported by a fixture which is adjusted at the end of the bed until the bar is properly lined up, when the finish cut is taken through the casting. In the event of the test just referred to showing lack of alinement in these holes, the outboard support for the boring bar is adjusted to aline the bar properly and the holes are then finished.

ARRANGEMENT OF SPINDLE BEARINGS

The next operation is the boring out to size, that is, the taking of the finishing cuts, for the spindle bearings. These holes are bored straight and later on are fitted with cast-iron shells which are tapered inside to receive the phosphor-bronze boxes for the spindles. The boxes are tapered externally to fit the tapered

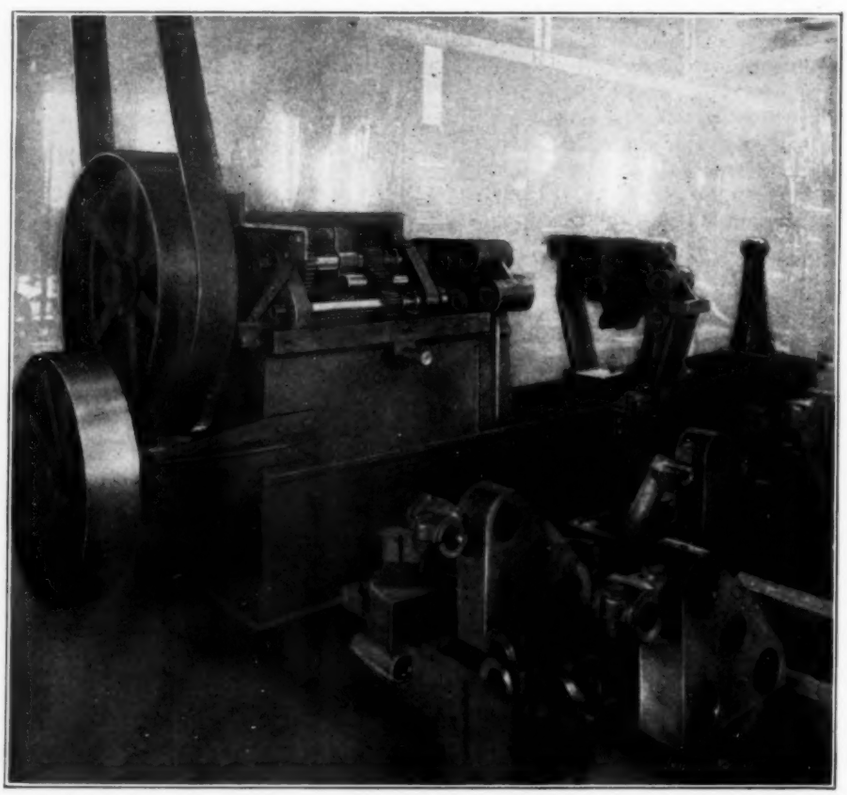


FIG. 3. MULTIPLE-SPINDLE HORIZONTAL BORING MACHINE

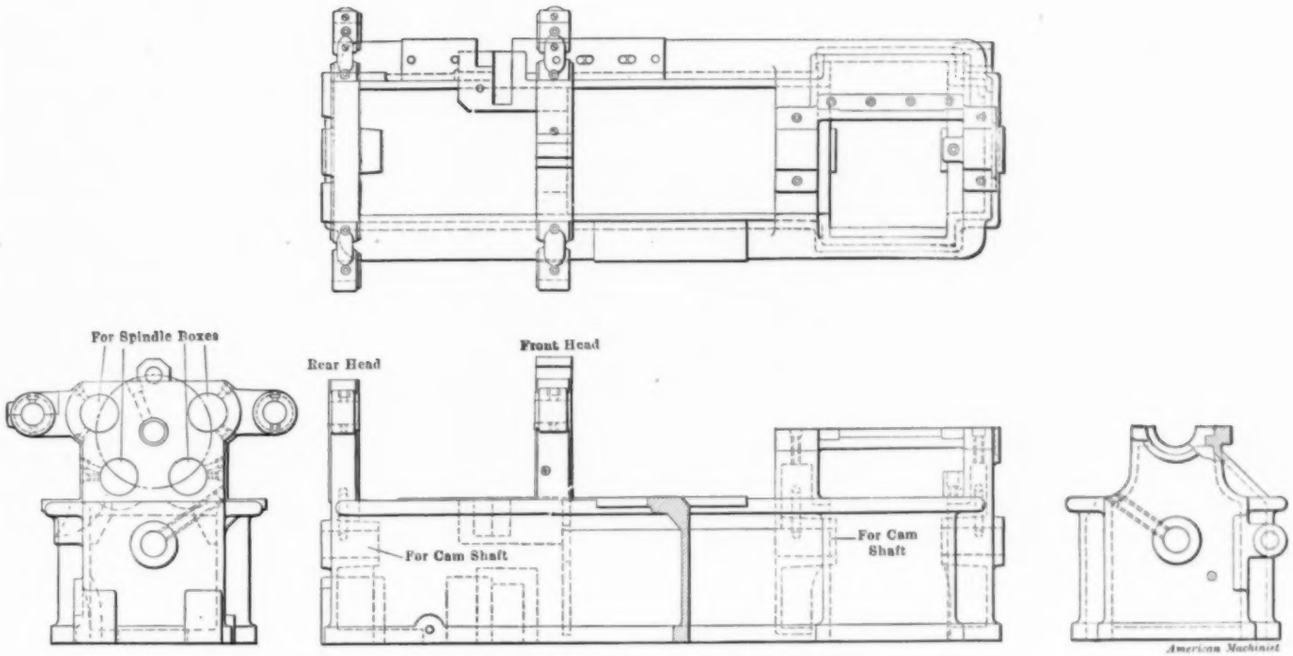


FIG. 4. BED AND HEAD OF PRENTICE AUTOMATIC TURRET MACHINE

seats formed in the cast-iron shells and are finished cylindrically in the bore to receive the spindles. They are split clear through along one side and have two slits cut partially through at points 120 degrees from the first slot, thus allowing for taking up wear by means of a nut upon the threaded end of the box. The general construction is shown in the drawing, Fig. 7.

Considering the four-spindle machine, the upper spindle at the front is called the first or roughing spindle, the one below the second spindle, the bottom one at the back the third or finishing spindle, as this generally is used for finish boring or turning operations, and the upper spindle at the back, which is the fourth, is quite commonly employed for reaming or threading purposes. When the machine is fitted with this fourth spindle arranged for threading, the spindle bearing is of different construction from that described in connection with the other spindles. In this case the cast-iron receiving shell for the bronze box is dispensed with and a straight cylindrical bronze sleeve fitted directly in the head of the machine. In this straight bearing runs the extended hub of the gear which operates the spindle.

FINISHING SEATS FOR SPINDLE BOXES

In preparing to bore the holes to size in the head end for the spindle boxes, the work is placed upon another surface plate which is called the reboring plate, and here it is again lined up with the edge and upper surface of the plate. In this case the turret barrel or shaft is placed in its bearings and used as the working point for the test indicator in forming the alinement upon the plate.

The finishing of the holes for the spindle boxes is accomplished by a bar supported at its inner end by a hardened and ground pilot which runs in a bearing formed in a fixture attached to the nose of the turret barrel, as illustrated in Fig. 8, while the outer end of the bar runs in a special support carried at the end of the work. The machine illustrated in this view is of a different size than the one in Fig. 6, but the method of handling is the same. The fixture attached to the nose of the turret barrel gives the exact center distance or the radius upon which the centers of the spindles are located, the fixture for the outer end of the bar having, of course, the same center distance for the holes. In this operation the turret barrel carries the indexing wheel and it is locked by this wheel during the finish boring operation. Now, with the boring bar in place, as shown in Fig. 8, it is tested with the indicator as previously described to assure correct alinement with the turret barrel and the finishing cut taken through the holes for, say the first spindle. The bar is then removed, the turret barrel indexed to the next position, the bar replaced, tested again for alinement, and the holes bored for the next spindle. This course of procedure is followed with the remaining holes.

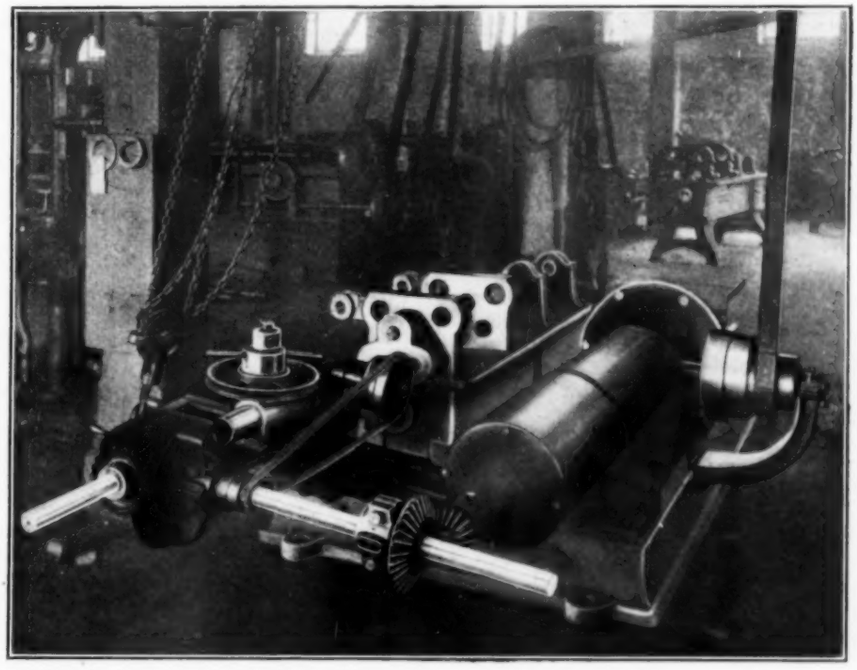


FIG. 5. A RADIAL DRILL CONVERTED INTO A HORIZONTAL BORING MACHINE

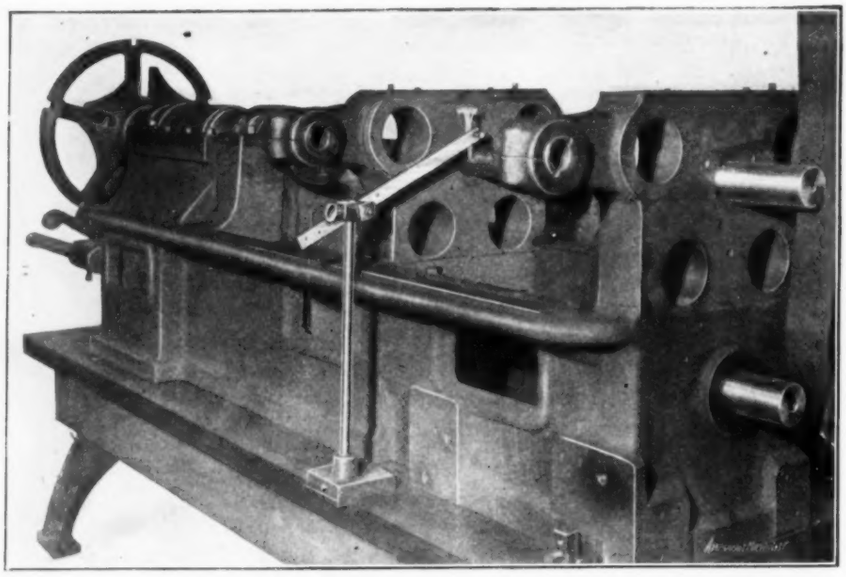


FIG. 6. ALINING THE MACHINE ON THE SURFACE PLATE WITH A TEST INDICATOR

but adjustable endwise by means of nuts operating upon threaded portions of the bar at either end of the conical sleeve. When this bar is placed in the shells to be tested, the sliding taper member is drawn up by the adjusting nuts until the bar is properly seated in its bearings. The test indicator is then applied to the bar and any inaccuracy in either the front or back shell for the spindle boxes is readily located and corrected by scraping the internal taper surface. In this way errors are easily detected and rectified, so that when the spindle is replaced with its bronze boxes it will be in proper alinement with its fellows and with the turret barrel.

MAKING BRONZE BOXES FOR THE SPINDLES

At this point a brief digression from the main subject may be permitted in order that a few interesting features may be pointed out in connection with the preparation of the phosphor-bronze boxes in which the tool spindles operate. As already stated, the boxes are of straight bore, but tapered externally. In machining them they are first chucked and rough bored and roughed straight on the outside in a turret lathe; they are then placed on an arbor in the engine lathe where the outside is turned taper somewhat above size, after which the thread is cut at the small end for the nut in a Pratt & Whitney thread miller. The box is then split along one side, the two opposite slits cut in the milling machine and the oil holes drilled through the walls. Next the box is placed in a fixture in the grinding machine, and while held under practically the same tension with which it will later be seated in its place in the head of the turret machine, it is internally ground to correct size for the spindle and is then slipped on an arbor and the taper exterior also accurately finished by grinding. This method produces a box that will fit properly in its seat, hold its shape well and give a good bearing surface for the spindle.

ASSEMBLING THE SPINDLE BOXES

The hole for the spindle boxes and seats having been completed, the cast-iron shells referred to are put in place and the bronze boxes placed in the shells, the spindles slipped into place in their boxes and the machine then set under a countershaft and run from 24 to 48 hours to seat the spindles properly. It is then put back on another surface plate and the alinement of each spindle tested by working again from the edge and top face of the plate. As with the previous setting the work is here alined upon the plate before testing the spindles, by setting from the turret shaft. If this inspection reveals any inaccuracy in the alinement of any spindle the bronze boxes for that spindle are withdrawn from their cast-iron shells and a bar slipped into the taper holes in the shells to test them. This test bar is of steel having at one end an enlarged taper portion accurately ground and lapped to conform to the taper required in the cast-iron shells, while at the other end the bar is provided with a sliding sleeve ground to the same taper

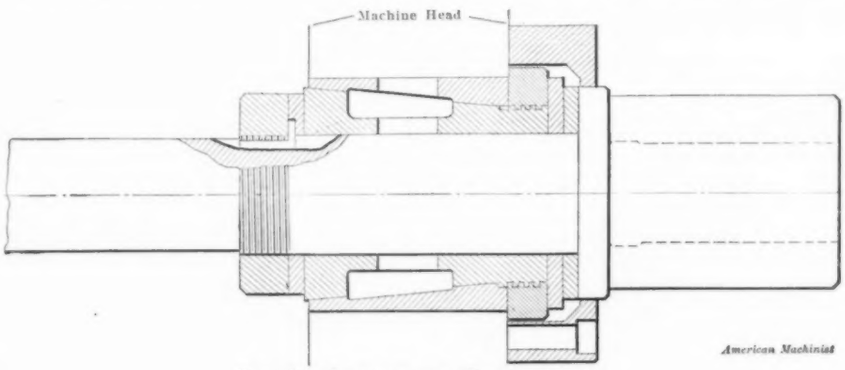


FIG. 7. SPINDLE-BOX CONSTRUCTION

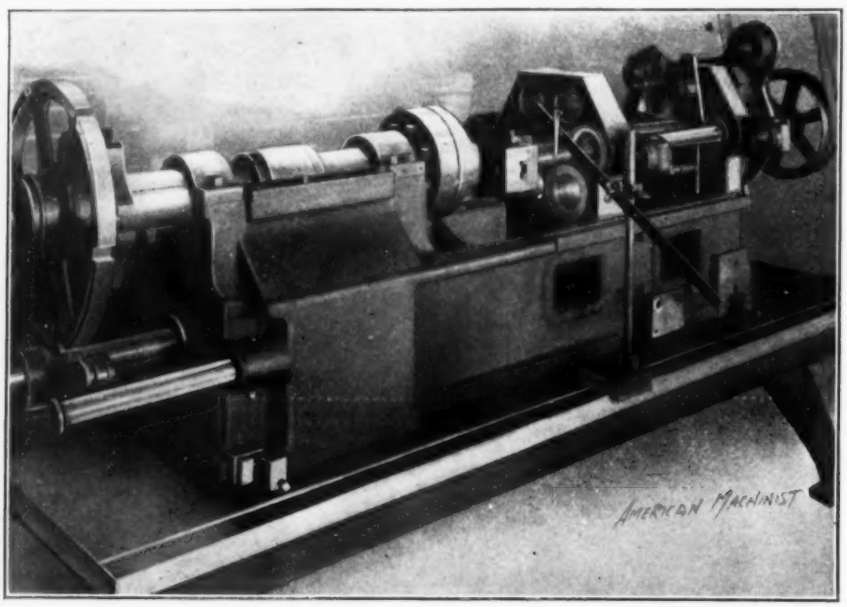


FIG. 8. REBORING SEATS FOR SPINDLE BOXES

SPINDLE TESTS

One of the most interesting tests in the series on this machine is that which proves the accuracy of the indexing in reference to the position of the spin-

dles, and an illustration of which is presented in Fig. 9. At this point a hardened and ground test plug adjustably mounted upon a block which is slipped into one of the chuck-jaw slots is brought into contact with the Starrett test indicator mounted at the end of one of the spindles, the test plug being adjusted until the indicator when revolved in contact with the plug by rotating the spindle by hand, shows the plug to be absolutely in line with that spindle. Next, the indicator holder is shifted to the next spindle, the chuck is indexed to its second position, and the test plug carried in that portion of the chuck again tested with the indicator by rotating the spindle. The work chuck with the test plug is again indexed, the indicator shifted to the next spindle and the test repeated. As a further check the test plug is shifted to another slot in the chuck and the procedure just described repeated. The second setting of the test plug is usually in a slot opposite the one employed for the first set of tests around the different spindles. This inspection will reveal any variation in the spacing of the spindles and the index wheel.

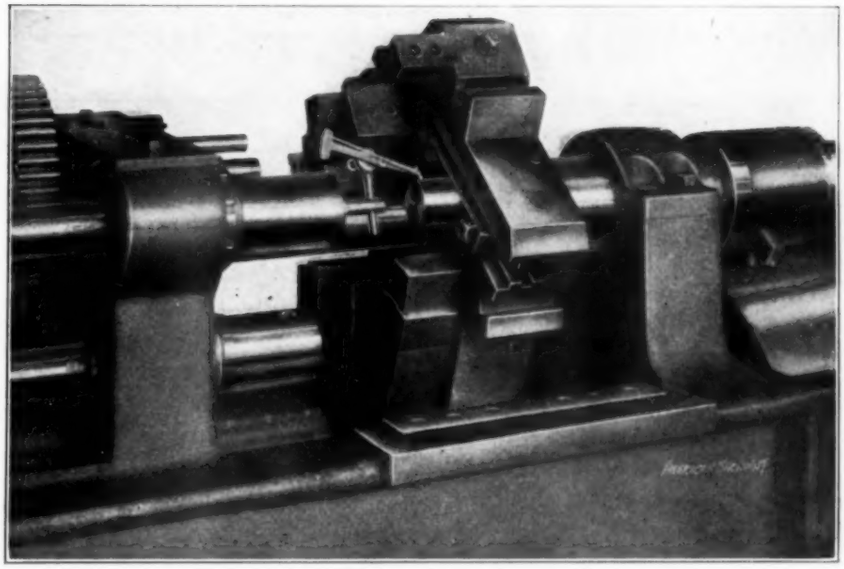


FIG. 9. A SPINDLE TEST

OTHER SPINDLE TESTS

Other tests are sometimes made by slipping a soft plug into the chuck jaws and turning it up with a tool in one of the spindles, the test indicator being then applied as before. Still another test consists in removing the rear spindle box, and with only the front box in place rotating the spindle with an indicator in its nose and with the contact point of the indicator resting on a test piece in the chuck. This shows whether the bearing in the front box is perfectly parallel, as any deviation from a true bearing along the spindle will allow the latter to drop at the rear end and when the rear box is slid back into place the change in the position of the spindle will be registered by the action of the indicator upon the test plug. A further test with the indicator is made by placing the block carrying the indicator on one spindle and sliding it along with the heel of the pointer in contact with the spindle above. This shows whether these two spindles are parallel with each other.

Before each machine is considered completed, a piece of work involving boring and turning operations is slipped into the chuck and indexed around to the various tool stations while the interior is bored and a series of steps turned upon the outside diameter by means of the cutting tools, held in the different spindles. The work is then removed and tested for concentricity of bore and exterior by applying a micrometer to the wall of the piece, testing its thickness at various points around the circumference and upon the various steps produced by the different cutting tools. It is obvious that any lack of alinement between the indexed stations for the chuck and the corresponding spindle positions will be discovered through the medium of this test. Finally the entire series of tests is verified by putting the machine bodily on a final test plate and going over and checking all of the alinement and other tests.

ERECTING AND TESTING FLOOR

A view taken at one end of a row of turret machines undergoing assembling and testing operations is represented in Fig. 10. The machine in the immediate foreground is practically complete, the tools have been put in place in the spindle, and testing cuts made upon work carried in the chucks. The machines a little further down the line are not so far advanced. Toward the upper end of the row there are two or three machines upon which most of the tests during assembling have been performed, and as these machines are eventually assembled, they will be taken one by one to the final testing plates located at the back of this row where all previous tests made at various stages in the fitting-up process will be carefully checked and verified before the machine is replaced upon its own legs ready for shipment.

Some tools and methods devised for machining index wheels, chucks and other important members of the Prentice turret machines will be illustrated in another article.

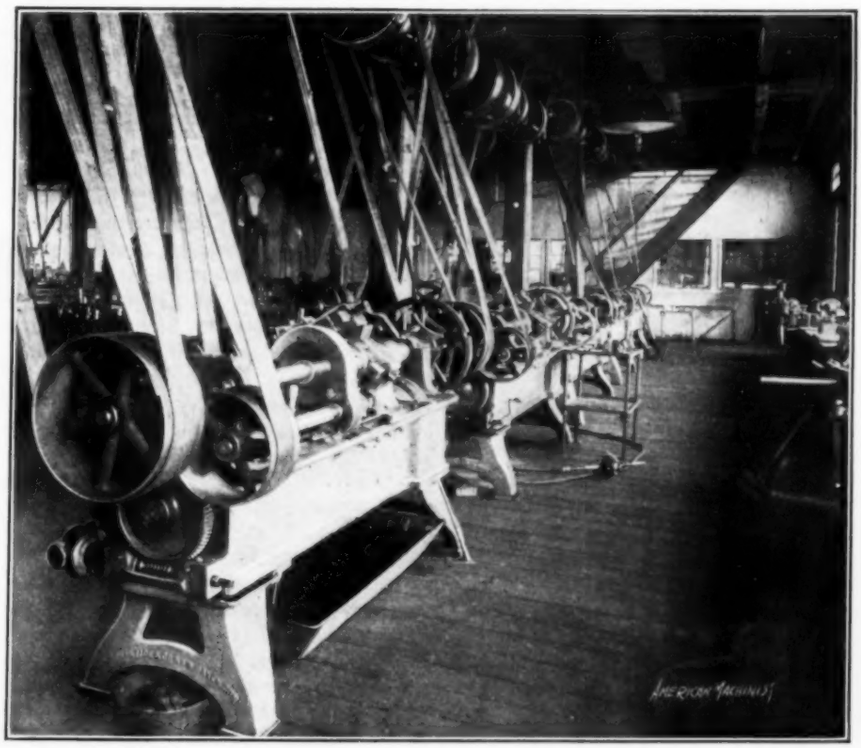


FIG. 10. ROW OF MACHINES ON ERECTING AND TESTING FLOOR

What Is the Force of a Blow?

By S. B. Redfield

Some time ago the catalog of a manufacturer of rock drills came into my hands and under the specifications of each of the different sizes of drill was given the item "Force of the Blow Delivered."

Upon taking up the matter with the manufacturers' engineers, as a matter of interest, it was admitted that nobody knew where the figures had come from, nor how they were calculated. They had simply been handed down from edition to edition of the catalog, always using the previous edition as authority.

In Kent's "Mechanical Engineers' Pocket Book," on page 430 is the following statement referring to the question of the force of a blow: "The question cannot be answered directly and it is based upon a misconception or ignorance of fundamental mechanical laws."

There is a great deal of this "misconception" (I hesitate to say "ignorance") and some remarks on the subject should be of interest.

When a body of a given weight is lifted through a given distance, work is done upon that body against the action of gravity, equal to the product of the weight by the distance lifted through. When this body is allowed to fall again, this work is transformed into energy of motion and when the body strikes an obstacle, the act of stopping the body forces it to give up its energy of motion, resulting in deformation or breakage and heat.

Just as the work done upon the body in lifting it against gravity is the product of a force (weight) and a distance (hight) so the work done when the body stops falling must be the product of a force and a distance. The distance is the penetration of one of the bodies into the other, or the deformation and the force exerted is the "force of the blow" about which we are talking. As the work done by the blow must equal the work stored in the falling body, the product of the force of the blow and the depth of penetration must be constant and equal to this stored work. If the substances are tough and penetration is slight, the force of the blow must be correspondingly great. Similarly, if the bodies are soft and pentration is relatively great, the force of the blow must be relatively small, because, as said, the product of the two must be constant.

As an example let us take a 2000-pound drop hammer and let it fall upon the work from a hight of 5 feet. Now, neglecting friction in order to simplify matters, when that hammer was raised up to the hight of 5 feet by the driving mechanism, the work done upon it was the product of the weight and the distance, or 10,000 foot-pounds.

When released, the hammer will fall and again neglecting friction, the 10,000 foot-pounds of stored work or energy which it received from the driving belt, will have been transformed into velocity and when it strikes the piece on the anvil block this velocity will again be changed back into work; the product of force and distance.

Suppose, for instance, that the deformation of the piece allows the hammer to sink down half an inch after it first strikes. This is the "distance" and is 1/24 of a foot. Since the total work available in the moving hammer head is 10,000 foot-pounds and since the distance moved through while the hammer is giving up this work is 1/24 of a foot, the average force exerted upon the piece must be 10,000 divided by 1/24 or 240,000 pounds. This is the force of this particular blow.

Now suppose the piece is harder than that just considered, and that when the 2000-pound head has dropped 5 feet, the penetration after striking the piece is only ¼ inch or 1/48 foot. Then by the same reasoning as before, the average force exerted must be 10,000 divided by 1/48 or 480,000 pounds.

Thus it is seen that the force of the blow depends upon the hardness of the body struck, for the harder it is, the less the penetration or "distance" and so, the greater the force of the blow must be.

Similarly, if the piece were very soft, and the penetration were, say, 2 inches or ⅙ foot, the average force of the blow would be 10,000 divided by ⅙ or 60,000 pounds.

So far, we have considered only a falling weight. Let us return to the case of the rock drill. Suppose that a 3½-inch diameter drill has an average effective air pressure behind its piston, of 60 pounds per square inch; that the moving parts—piston, piston rod and steel—weigh 100 pounds and have a total stroke of 9 inches. Also let the penetration into the rock be 1/16 inch at a blow.

Here the problem is complicated by the work done by the air on the downward stroke. We will simplify the case by assuming that the air pressure is removed exactly at the instant of stopping and that there is no cushioning of air in the lower end of the cylinder.

In falling through the 9-inch stroke (¾ foot), the 100 pounds of weight will be able to do $100 \times ¾ = 75$ foot-pounds of work. The average air pressure of 60 pounds per square inch above the 3½-inch diameter piston will exert a downward force of $60 \times 9.62 = 577$ pounds. This, acting through the 9-inch stroke, would put energy, or work, into the parts to the amount of $577 \times ¾ = 432$ foot-pounds. This would show itself in increased velocity of the moving parts.

From this we have that the total work available in the descending mechanism, again neglecting friction, would be $75 + 432 = 507$ foot-pounds. Since the penetration is 1/16 inch or 1/192 of a foot, the average force of the blow will be 507 divided by 1/192 or 97,344 pounds.

Again, if the rock were very soft and the penetration were twice as great, the average force would be half as much or 48,672 pounds.

This same method of reasoning might be applied to a steam hammer with the result that a 24,000-pound hammer with a 36-inch diameter piston having 30 pounds average effective steam pressure behind it, dropping 6 feet and penetrating 1 inch would exert an average force of blow of 3,927,000 pounds.

A common-sense example of the fact that the force of this blow depends upon the resisting power of the piece struck, is that a certain blow which would fracture a piece of hardened steel might do no harm at all to a piece of rubber. The steel would be penetrated so little that the enormous force resulting would fracture it, while the great movement of the rubber would allow the force of the blow to be so small as to do no damage.

The question may be asked, "What becomes of this work that is delivered by the falling weight?" It is used up in deforming and heating the piece which is struck by it, and also, to considerable extent, in the rebound of the parts, vibration of the earth, etc. This last pheonmenon is a clear evidence of the force of the blow of a steam hammer. When the piece being forged is hot and soft, the vibration of the earth is nowhere near so great as when it becomes cold and hard, offering more resistance to the blow, with the same drop and steam admission.

As indicated, the force of the blow calculated in this manner is only the average force during the time of crushing the materials. At the first contact, the material would be softer than after compression and consequently the force of the blow delivered would be comparatively light at first, rapidly increasing to a high maximum many times greater than the calculated average, as the particles become more crowded together, stopping the motion of the falling hammer. For this reason the calculation of the actual "force of a blow" at any instant is even more indeterminate than might at first be supposed.

Published Records of Machine Tool Performance *By W. Groocock*

At page 921, Volume 32, Part 2, in an editorial on the above subject, the question is really put thus, should machine records be published?

Yes, certainly they should, and the superintendent quoted in the editorial really answers it in this way, though not in words, when he goes into the shop and tries to equal or beat the record in question.

A Demonstrator in Every Shop

There is no valid reason why the ordinary shop should not put up better time on a job than that made by an outside demonstrator who, though admittedly an expert on his particular machine, is often a stranger to the job, and is consequently somewhat at a disadvantage. Why not have a demonstrator or two in every shop, or, looking at the question from the broader point of view, which is the one taken in the editorial, why is not every man in the shop a demonstrator in the sense that he tries to do the work in the shortest possible time? Now this brings us back to the old, old question, does it pay?

If it can be proved that it pays to do the work as quickly as possible, then there are plenty of men in all shops who would soon cut many existing times in half, and in nearly all cases a considerable reduction would be made. It may be argued that this is looking at it from a purely selfish standpoint.

Well, what if it is? We must take things as we find them, and this has been my experience. While working as a mechanic in a dozen shops, I have never failed to notice that there were several men in each who stood head and shoulders above their fellows in the matter of output, whether considered with regard to time, or finish, and in many of the shops this class of man would be getting the same pay as the average man, or at most 50 cents a week more.

Some Incentive Necessary

Now many of these men would have made excellent demonstrators or record breakers were it not for the fact that it's against human nature to expect a man to pile up a record which he himself must live up to for the rest of his working life, without any, or only a meager, additional consolation at the end of the week.

The spirit of competition is strong in the majority of men of our race, but so is the gift of common sense, and common sense says, don't do it without adequate reward. The independent demonstrator knows that after he has made good on a job he has finished with it, while the man in the shop has to go on, on, on, so that the attitude of the workman when we look at it from his point of view, is both logical and natural.

The premium system of pay has undoubtedly raised the standard of output, but the men recognize in this, as they did in piece work, that their output today is the standard for the future, the times for which will be based on their present efforts, and although there may not be any coördinated effort to do so, there is an unspoken and perhaps natural desire to keep something up their sleeve.

Demonstrating and Rate Fixing

Demonstrating and rate fixing are so much akin that they naturally should belong to the same branch, but wherever rate-fixing branches have been adopted, in works I am acquainted with, they have dropped the idea of demonstrating, I fancy, for two reasons: First, it's easier to talk than work, and secondly, working is so beastly dirty. The net result of this is they refer back to some job done 12 years ago, or try to draw a line through some performance on a job with which none but themselves can discern the faintest similarity, and which in any case may be a long way out.

It would occur to one that the publication of machine records would be a blessing to rate fixers, but I have generally found that they are the last people to believe, that such and such a job was milled in so many minutes, or that 20 of these shafts were ground in the hour, and it is usual to hear them express disbelief as to the times and also in the materials used. This, to my mind, smacks of the ostrich who, as the story goes, sticks its head in the sand and then imagines because it can't see it cannot be seen.

Yes, undoubtedly these records should be published, the more we have the better, although many of us, in common with the superintendent quoted, have had a warm half-hour through them.

A Question to the Point

Where would grinding be today if the makers of the machines had not demonstrated what could be done and published the records?

Who can read the articles in the American Machinist by Mr. Darbyshire without being interested in the possibilities of grinding? And who has had the privilege of watching this expert demonstrator at work without being absolutely convinced of the superior value of the demonstrator over the rate fixer, when it comes to the point of persuading a workman that the time set is a good one?

Again I say, let us have demonstrators, let the American Machinist publish their records, and let us in turn be up and doing, trying our best to beat them.

Where the Steel Expert Fell Down

A friend of mine uses tons and tons of tool steel for cutting tools and has to be mighty careful of the stuff he gets because his customers have the habit of expecting them to stand up in severe work. So he makes physical tests, depends a lot on fractures, and studies the etched surfaces under a microscope. Then, too, he photographs these etched surfaces with a magnifying lens and sends the photo to an expert metallurgical sharp to examine.

Awhile ago he had a lot of steel where the outer surface seemed to be soft, but the rest was fine as silk. Still the outer surface has to be considered in making a cutting tool and he entered a vigorous protest with the steel maker. A microphotograph showed a ring around the outside but the aforesaid expert reported it to be O. K. and no indication that it was soft.

So another sample was prepared, photographed and sent on for examination. The structure was a trifle peculiar, but the expert's report made it out to be a pretty fair sample of steel in spite of it.

And now this friend of mine is wondering just how much reliance can be placed on these examinations of microphotographs, because the last one he sent him wasn't from steel at all but from a *cross-section of sugar cookie* he borrowed from the office boy's lunch box.

Sounds fishy—but he swears it's true and offers to trot out the expert's report of the examination.

Removing Broken Screws—Tumbling Small Steel

Sometimes it is very puzzling to know how to remove a broken screw or tap from a hole. After all the usual methods have been tried and have failed, melt some wax over the end and scrape a slot down to the broken piece. After a dam has been made of wax to retain the etching acid a screwdriver slot can be etched in the end. A good mixture to use for this is muriatic acid 1 part, nitric acid 1 part and water 4 parts.

Very satisfactory results have been obtained by using air-slacked lime when tumbling small steel parts which have been hardened. It will make them bright and will remove the sharp edges, leaving them in fine condition for nickeling.

The GRINDING MACHINE in AUTOMOBILE SHOPS

Parts Are Produced Economically on the Cylinder Grinder

BY H. DARBYSHIRE *

The remarkable development of the automobile industry has brought to light many interesting grinding jobs. The fact of its being a business that is to some extent standardized has been an incentive to designers of grinding machinery to give it some special attention, both in the way of special fixtures for existing types of machines and machines of a special type. The grinding of cylinders is an instance of this, but the fine examples quickly ground and duplicated. Many jobs in the trade call for special arrangements on all makes of grinding machines, one instance being the surface grinding of the square gear shaft as carried out on the Brown & Sharpe universal machine; here the shaft is held on centers in a pair of dividing heads, the wheel spindle is set at right angles with the shaft and the shafts are traversed by hand feed over the face of a cup wheel.

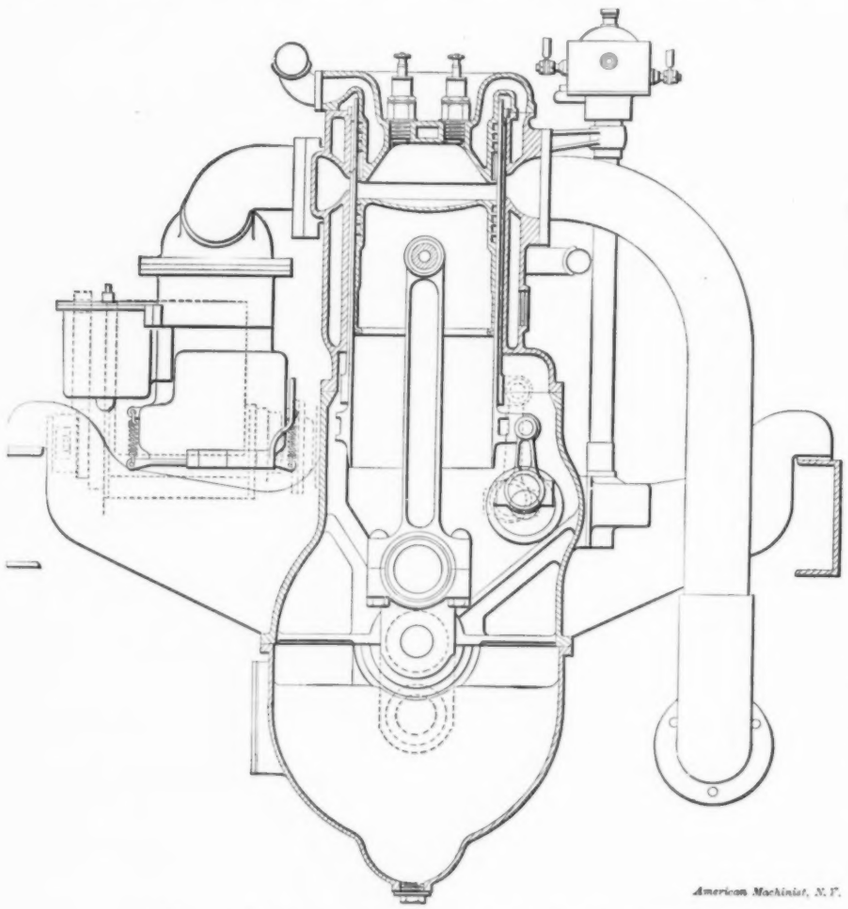


FIG. 1. SECTIONAL VIEW OF KNIGHT SILENT ENGINE

of boring which I have seen in connection with this work would almost seem to point to this after grinding as being an unnecessary luxury.

CAM SHAFT AND OTHER WORK

The Norton Grinding Company has designed a fixture by which cams and their shafts may be ground from the drop forging without the necessity of using the lathe at all, also an additional fixture by means of which poppet valves may be

One job of especial interest is the machining and grinding of the sleeves in the Knight silent engine as carried out by the Daimler Motor Company of Coventry, England. It cannot be claimed that there are any remarkable points about this particular job if we except that of accuracy and interchangeability; I recently examined and tested some dozens of these sleeves without discerning a difference of 0.01 millimeter. The sectional view of the engine, Fig. 1, will give a general idea of its construction and the absence of the usual type of poppet valve may be noticed; it has in fact been called a valveless engine but this is only partly true for the sleeves are introduced to serve the same purpose.

FEATURES OF THE KNIGHT ENGINE

A more detailed description of the engine may be gathered by perusing Mr. Knight's excellent paper read before the R. A. C. of Great Britain. What is claimed for this engine is greater fuel efficiency for upon the bench one horsepower per hour is produced with from 0.54 to 0.64 pint of petrol, according to compression. Greater comparative flexibility is a marked feature of this engine, from 4 to 60 miles per hour without change of gear is not difficult, in short the flexibility of this motor approaches so closely that of steam as to leave little to be desired. In regard to the particular feature of the sleeves in the engine the following extract from Mr. Knight's paper is of interest:

"The minute a motor with uneven thickness of cylinder walls becomes highly heated, the metal goes out of round to the extent of several thousandths of an inch. These gases either blow or burn out the lubricating oil and cause further heat and distortion, which in case of continued hard work ultimately cause seizure of the piston and the destruction of some part. Distorting cylinder walls also let heat which should go to the exhaust into the motor base and endanger the life of the bearings. I believe that the failure of so many motors upon Brooklands has not been due so much to improper lubrication or cooling as to the fact that continued maximum load caused cylinder distortion, ring blow-by and consequent apparent failure of lubrication.

"In the case of the new motor we have as the cylinder in which the piston works a sleeve or tube of absolutely even thickness. So uniform is its expansion under heat that it will, without injury, work a dead fit under heat, with its outside member. In the water-jacketed cylinder which carries the ports, we cannot, however, have such uniformity, and this cylinder is subject to distortion. But as we do not depend upon this member to hold compression, the piston not coming in contact with it at all, it is a simple matter to make allowance for such irregularities.

"After a new motor has been "run in" for a few hours under its own power, the brake is put on and it is brought up to about three-quarters load. It is run under these conditions until thoroughly heated, in order that the outer cylinder

*European demonstrator, Norton Grinding Company.

or waterjacket may go out of shape to the extreme limit. The motor is then taken down, and it is found, as a matter of course, that every point of distortion is marked upon its walls by the outer sleeve through friction marks. The cylinder is then treated as we treat a bearing which is being fitted, the high spots being

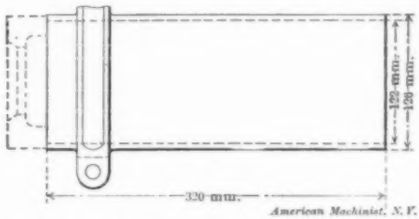


FIG. 2. APPROXIMATE SIZE OF INNER SLEEVE. CHUCKING PIECE SHOWN BY DOTTED LINES AT END

scraped away. It is a very short job, and when all four cylinders are so scraped the motor is reassembled for doing its full power. The test then proceeds, and after the motor has received the O. K. of the superintendent, it is again taken down and inspected prior to its being sent away to its chassis. If, after the scraping-in that it has previously undergone, high spots still manifest themselves, these faces are again scraped.

"By taking away these high spots we prevent high spots on the outer jacket pressing against the sleeves, and, in turn, causing the latter to pinch the piston. The result is that the sleeves invariably stay round. The piston never requires relieving upon any side, unless it chances to be too large, and I may say we practically never find it necessary to touch up the rings. When the motor goes out upon the road, it runs cool all over, does not knock or pound, and is remarkably easy to lubricate. It is also, I need not

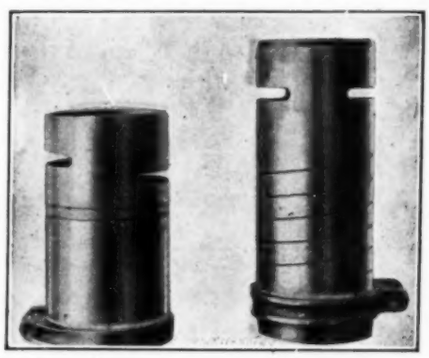


FIG. 3. SLEEVES FOR KNIGHT SILENT ENGINE

hesitate to say, marvellously efficient, and never fails in its power at critical moments when being hard worked."

MACHINING THE SLEEVES

Of these sleeves it was formerly thought to be a necessity that they be a very close fit both in the cylinder and within each other so as to prevent the escape of any explosive gases; later practice has shown that this is not necessary but the sleeves are still made to a fine limit to insure interchangeability. The castings are made of a special fine quality of gray iron and are cast with an extension piece on one end for convenience of chucking. They are first bored and turned on the end to suit the chucking fixture, as shown in Fig. 2, the edge of the bore being chamfered to an angle suitable for the grinding-machine centers. The operations of rough boring and turning are done simultaneously on a turret lathe fitted with a jig chuck, 1.5 millimeter being left on the internal diameter and 1 millimeter on the external, for removal by grinding and finish boring; the front end of the hole is also chamfered true with the back edge. The next operation consists of rough grinding the outer diameter which has to be to a fixed size so as to insure its fitting the special fixtures provided for finish boring and grinding; the rough grinding is done in a few minutes on a 10x50-inch Norton plain grinding machine fitted with revolving centers and using a 24K alundum wheel. The sleeves, after having the extension piece parted off, are now scored for lubrication and the ports and lugs milled out as shown in Fig. 3, they afterward being finish bored; for this purpose they are pushed into a stationary bushing and prevented from turning by having the lug clamped on the end of the bushing. This bushing is inclosed in a tank with a supply of water running constantly through it for cooling purposes, an ordinary cutter bar is used with supporting bushes at each end and two roughing tools and one finishing tool are used, 0.1 millimeter to 0.2 millimeter is left in the bore for removal by grinding and the sleeves are bored at the rate of 5 per hour.

SLEEVE GRINDING OPERATIONS

For grinding the bore a special chucking device is fitted to a No. 3 Brown & Sharpe universal grinder work table. This consists of a revolving cylinder, with pulley in the middle, which runs in housings bolted to the table and is driven from the overhead work drum. The sleeves are merely pressed into this cylinder by hand which shows that the previous rough grinding must be done very accurately. A full stream of water is kept running on the grinding wheel and the holes are ground quite straight and to size in some 20 minutes each. The last operation consists in grinding the external diameter, which is accomplished on a 10-inch by 50-inch Norton machine the sleeves being hand pressed on to an ordinary arbor and the grinding being a matter of a few minutes. The point most worthy of note in this job is the cheap production when we consider the accuracy required and obtained, together with the sectional construction; the walls of the bore being very thin necessitate the utmost care in every operation to prevent any springing.

FOUR- AND SIX-THROW CRANK SHAFTS

Other grinding jobs about this engine worthy of special notice are the cranks, both four and six throw; shown in Figs. 4 and 5. These are beautiful examples of this class of work and are ground to a very fine limit. In both cases the cranks are ground from slab forgings of nickel steel, the throws being milled out in a Muir crank miller. Fig. 6 shows the

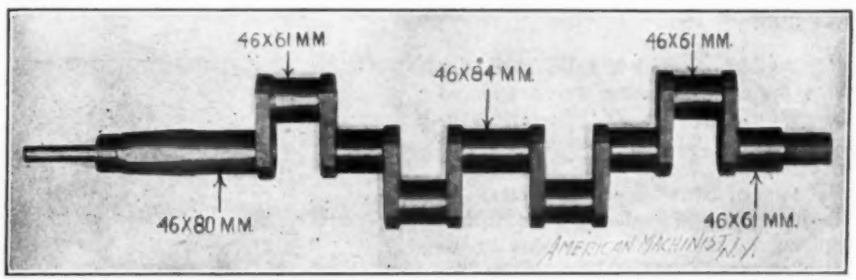


FIG. 4. FOUR-THROW CRANKSHAFTS GROUND IN 3½ HOURS

cranks and sleeves assembled together with the 2 to 1 eccentric shaft which actuates the sleeves. It should be said here that the sleeves already described together with openings or ports in the walls of the cylinders replace the ordinary mushroom type of valve. The sleeves obtain their movement by being connected to separate eccentrics on the shaft, the stroke being limited to about 1 inch and the shaft being driven by a silent chain run off the crank shaft. The 6-throw eccentric shaft shown in Fig. 5 is quite a tricky grinding job but is done in excellent time and to a very fine limit. In the grinding operations, 0.7 millimeter is removed from each shaft, Figs. 4 and 5, the tolerance being 0.02 millimeter. The 4-throw shaft in Fig. 4 is ground in 3½ hours. The larger of the two 6-throw shafts in Fig. 5 requires 5½ hours for grinding, the smaller (the eccentric shaft) is ground in 2½ hours, with all the fillets ground to gage. The dimensions of bearings and pins are given in the engravings.

This firm has recognized the many advantages of grinding and make it a prominent feature in their valuable and modern plant. Some five years ago their

grinding plant consisted of two machines; now they have 13 Norton machines (two of which are crank grinders) one Landis and ten Brown & Sharpe universal and surface machines, besides several other machines. Interchangeability is insisted upon in all details of their manufacture and to view their fine plant and become conversant with their splendid organization is to understand the high reputation which their cars have obtained.

A Hollow Cam Shaft

One or two other automobile grinding jobs may be of interest, or rather the ultimate method adopted in some particular cases for obtaining what was considered the most profitable results by a large continental firm. The hollow cam shaft shown in Fig. 7 was made from drawn steel tube of 32 millimeter diameter: In the first place the shafts were turned with two separate chips leaving a grinding allowance of 0.25 millimeter, the time for this operation was 20 minutes and the time for grinding to a limit of 0.01 millimeter was 10 minutes, a total of 30 minutes. At my suggestion 10 of these shafts were turned with one rough chip, occupying 8 minutes, and a limit of 0.5 millimeter allowed in turning; about 0.8 millimeter was removed by grinding, this operation taking an average of 16 minutes, or a total of 24 minutes. The method of grinding them right out from the black tubing was also tried, this occupying some 28 minutes to remove the 2 millimeters of stock but ultimately the shafts were ground outright from 31-millimeter stock in a time which averaged 25 minutes. This method was considered the most economical for this particular job, some advantage being gained in engaging one machine only in their production and leaving the lathe at liberty for other work A 10x50-inch Norton machine was used for this work, using a 24L wheel, with a work speed of 35 feet per minute and a table feed of 8 feet per minute; five half-round steady shoes were used, spaced equidistantly.

There are scarcely enough data in the job here described to warrant the grinding of black material as a general practice, still it must be remembered that one machine operation was dispensed with and its attendant cost for handling, etc. To my own knowledge there is one large machine-tool firm who profess to make large savings per year in this line; they use large quantities of cast-steel bar stock in their automatic plant and a difficulty they found in the ordinary marketable bars was their uneven diameter, this, of course, causing trouble in the automatic gripping of the chuck. They have now for some time been buying stock 1 millimeter over size in 3 meter lengths and rough grinding it to a limit of 0.05 plus and minus; very cheap labor is employed and bars are ground in an average time of 40 minutes. This system they claim more than pays the difference in price of ordinary bars and especially reeled ones.

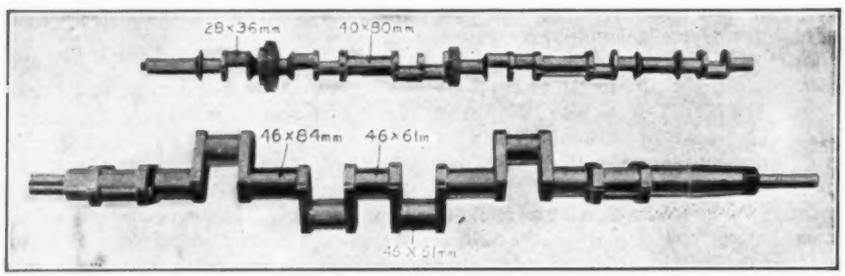


Fig. 5. Six-throw Eccentric and Crank Shafts Ground in 2½ and 5½ Hours, Respectively

Grinding Gear Shafts

With a similar work speed but a 6 feet per minute table feed, gear shafts like that shown in Fig. 8 were ground in a very accurate and satisfactory manner. These shafts were turned in a turret lathe, the cones being got out with a form tool held in the cross-slide. One wooden shoe was used as a steady rest in grinding and 0.25 millimeter of material was removed from the diameter. The time in detail was as follows: For the long part *A*, 60 were ground in 2 hours 40 minutes to a limit of 0.02 millimeter; on part *B*, 60 were ground in 64 minutes with practically no tolerance as they had to be a hand-press fit to a ball bearing ring; the 60 cones *C* were ground and fitted to ring gage in 3 hours, the same time being consumed in grinding cone *D*. There were gear wheels fitting on these coned ends, the limit for distance being 0.2 millimeter. The cones *C* were first ground to a ring gage and a ring gage was left on here when they were reversed in the machine. A scratch gage was then used as shown to mark where cone *D* should extend and this cone was ground until the line was split.

An interesting feature of this particular job was that 6 had been turned previously in the engine lathe with rough cuts leaving 0.8 millimeter for removal by grinding and 1 hour 50 minutes was consumed in grinding the 6 shafts; this works out at about 18 minutes each. When the turret lathe was utilized it was found quite safe to leave the finer grinding allowance and the grinding was done in a little over half the time per shaft. It should be said that the time for turning in the engine lathe was 90 minutes per shaft and in the turret lathe 12 minutes each.

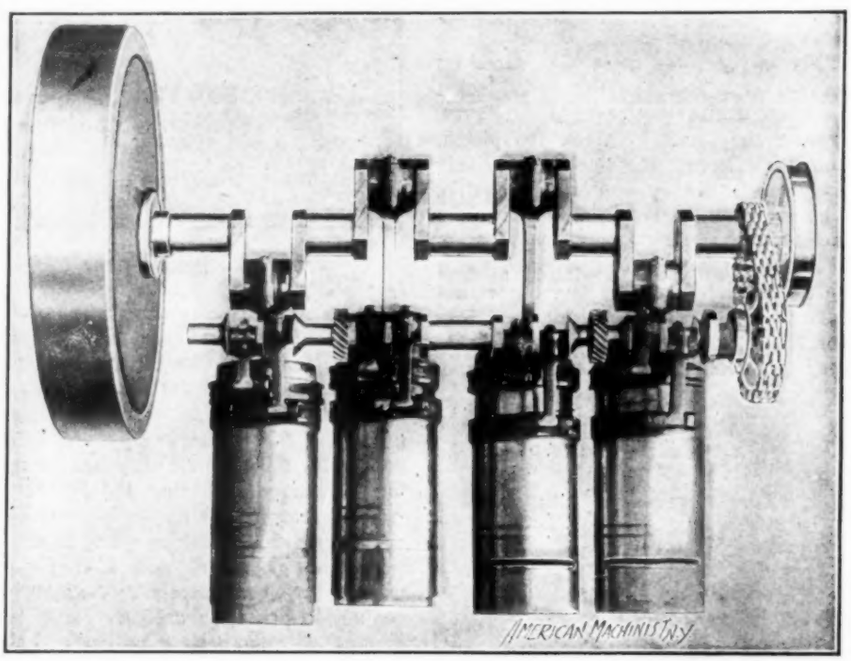


Fig. 6. Cranks and Sleeves Assembled

Chucking Pistons

For the grinding of automobile and gas-engine pistons there are various ways of chucking them, many of which have been explained in articles which have appeared in this journal. A method which was adopted at my suggestion proved very efficient and may be worth some little description. The pistons in question were

for gas engines of various sizes but a similar rig would, of course, apply to those of a smaller size, as in the automobile trade; all that is necessary is that the mouth of the piston be bored to a fixed size and within reasonable limits. The piston shown in the sketch, Fig. 9, was first machined in a Potter & Johnston semi-automatic, being first held in a chuck by the blind end, the body was turned with two chips leaving 0.025 inch for removal by grinding and the mouth bored to size; it was then reversed and held in a draw-back chuck to have the grooves formed and was faced off to length, leaving a small tit on the end which was centered true with the body. The pistons were then drilled and reamed in a jig to receive the piston pin.

For grinding the piston an arbor was provided in the form of an eye-bolt with hardened center, the arbor was machined as shown to a close fit in the clamping washer and was threaded, the eye of the arbor getting a pull on a pin with a radial groove which was passed through the piston-pin bore. The piston shown was ground in 13 minutes on a Norton 10x50-inch grinder. The body of the piston was first ground to size and then each section between the grooves had to be reduced 0.001 inch successively to allow for expansion: It was suggested that 0.010 to 0.015 only be left for removal by grinding in future as the turning came out very accurate and if this suggestion has been acted on the grinding time would easily be reduced to about one-half.

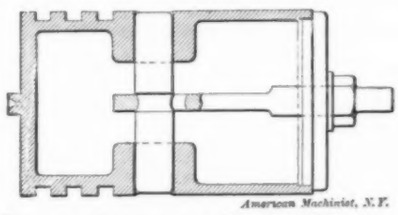


FIG. 9. GAS-ENGINE PISTON SHOWING ARRANGEMENT FOR CHUCKING FOR GRINDING

The wheel used was a 24J+ alundum, running at a speed of 6000 feet per minute, the work speed was about 38 feet per minute. Heavy roughing cuts were taken up to the last 0.002 inch of material, the wheel was then trued up and a few finishing chips taken.

ANOTHER CRANK-SHAFT JOB

In a few of these little jobs which have been described it is quite evident that too much had been left for removal by grinding in the first case, which is a very common mistake and will be considered later on. With regard to the grinding of crank shafts much progress has of late been made, the example shown in the sketch, Fig. 10, being an instance of this. This shape of crank shaft is now regularly produced on the Norton machine in an average time of 2 hours 50 minutes. The crank shafts are made from drop forgings and the time given is inclusive of that spent in the lathe for cutting to length, centering and turning ends for center bars. Some two years ago the total time for the machining of this crank was about six hours but thanks to experience and a few little attachments to the Norton machine gratifying results above noted are now being obtained.

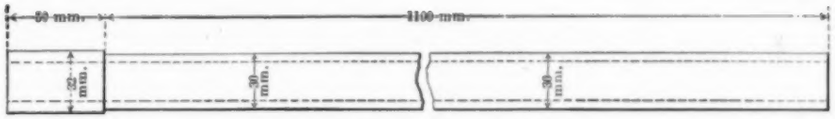


FIG. 7. Hollow Cam Shaft

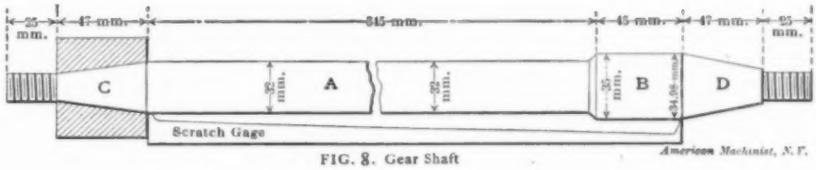


FIG. 8. Gear Shaft

GEAR SHAFT

GRINDING HARDENED STEEL RINGS

Some hundreds of hardened rings were wanted which were to serve as gear-case liners for roller bearings. They were of the shape shown in Fig. 11 and had to be very accurate, and interchangeable. The outer diameter was to be a press fit in the gear case and the holes had all to be duplicated on account of the rollers. The rings were made from lengths of annealed steel tubing of a size which allowed of 1/16 inch of material being removed from the outer diameter and the bore. These tubes were fed through the hollow spindle of a turret lathe and the rings were turned and bored leaving 0.010 inch for grinding both internally and externally. The corners were then rounded and the rings cut off 0.010 inch over finished length, the rings then had a second annealing and were afterward carbonized and hardened in the usual manner. It should be stated that this second annealing was found necessary owing to some scrap being made in the first batch that went through; owing to the want of annealing many of the rings had distorted so much in hardening that they would not clean up to size. The first grinding operation was to finish both ends to length, and for this purpose a Pratt & Whitney vertical-spindle machine was used. A number of the rings were first cleaned up on one end, and after these were all completed they were reversed on the chuck and the opposite end ground to length, the wheel being fed down to a dead stop; an alundum cup wheel of 30-grit grade K was used and the time occupied to grind the two ends was 35 seconds. Early experience had taught that even with the two annealings the rings were liable to go out of shape a little when the hard outer surface was ground so that two operations of roughing and finishing were resorted to.

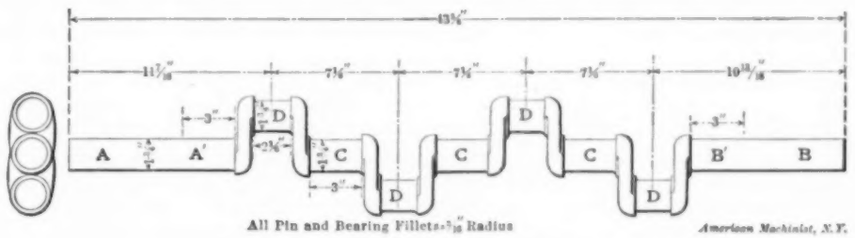


FIG. 10. ANOTHER CRANKSHAFT

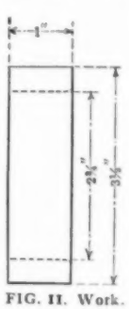


FIG. 11. Work.

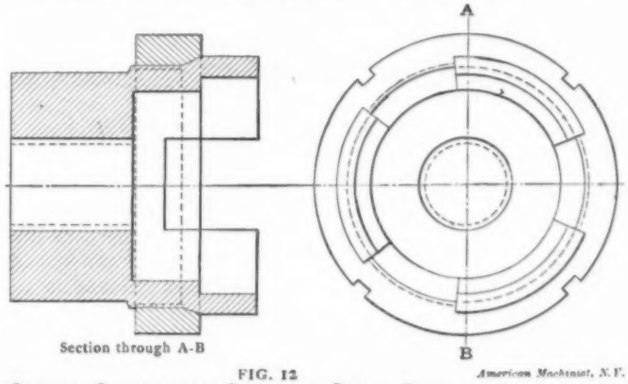


FIG. 12

ADJUSTABLE SPRING CHUCK FOR GRINDING RINGS INTERNALLY

ROUGHING AND FINISHING OPERATION

Rough grinding internally was the next operation and for this purpose an adjustable spring chuck, Fig. 12, was fitted to the universal head of a Brown & Sharpe grinder, a No. 8 Brown & Sharpe internal fixture was used with a wheel of 36-grit grade K, and the holes were rough ground to within about 0.004 inch of finished size, 7 minutes being consumed in the operation.

The rings were now strung on a parallel arbor which held ten rings and were held fast by a nut and washer while being ground. A 10x50-inch Norton machine was used carrying a 24J wheel and the ten rings were roughed down to 3.503 inch in 13 minutes including the setting. The rings were now allowed a day or two to season and were then placed on the same arbor and finished externally; any of those which had gone oval were eased off in the bore by means of a small wheel fixed on the bench grinding stand until they passed a free fit on the arbor, they were ground to a limit of 0.00025 inch + and — the time occupied being 16 minutes for the ten rings including setting. The same wheel was used as for roughing but it was nicely trued up. The last operation was finishing the bore, and for this a spring chuck was used similar to that for rough grinding but a 60-grit J wheel was employed. The holes were finish ground in 10 minutes to a limit of 0.00025 inch over size. A full stream of water was used in all grinding operations.

THE ADJUSTABLE SPRING CHUCK

This adustable spring chuck is a very useful and reliable tool for any work of this description and has a distinct advantage over the ordinary universal chuck. Any practical grinder hand knows from experience that jobs like the one described may be ground O. K. to gages in the ordinary self-centering chuck, but the work is of a different shape when released from the chuck, this more especially if the grinding is done dry and the work allowed to become only moderately warm. In the chuck or collar illustrated the adjusting nut is so regulated as to give just sufficient tension to prevent the work from slipping, while the holding segments are elastic enough to allow for any change of size or shape while the grinding operation is in progress. If at times they become slightly out of truth the nut can be closed down and a chip taken down the bore with the chuck in position in the machine. These chucks are easily and cheaply made from gray iron and for work of a lighter type they may be made with a taper shank to fit the center hole of the grinding-machine spindle instead of screwing direct on the spindle nose. It is just possible that in smaller sizes the segments would require relieving a little to reduce the springing tension which is, of course, a matter of experiment for any particular size of job.

Cutting a Steep Pitch Worm

The illustrations show a very interesting job of cutting a triple-thread worm having a lead of one turn in 10 inches and an outside diameter of about 8 inches. This was done at the shop of James Bertram & Sons, Dundas, Ontario, Canada, in a large engine lathe of their own make, which was arranged so as to have the spindle and the work driven from the lead screw, as is usually done in steep pitches of this kind.

The first step is to mark the three threads very lightly with a pointed tool and then to drill starting and stopping points in the proper positions as can be seen at each end of the thread. Fig. 1 shows the roughing tool at work and gives a good idea of the acute angle necessary to clear the thread in this case. It will also be noticed that the cutting tool has stepped sides for breaking the chips and making it easier to remove the stock.

After the thread has been roughed out it is finished with the tool shown in Fig. 2, this being turned around for photographing, to give a better idea of the shape necessary. The finishing cut is taken only on the left-hand or leading side of the thread and the work turned end for end in order to finish the other side as it is next to impossible to secure good results by attempting to cut on the other side of the thread. It will be noticed that although the cutting tool has a decided curve the sides of the thread appear practically straight as we look over the top and against the background.

This was for a heavy power transmission, and it is interesting to note that worm gearing is used very successfully in many parts of Canada in spite of the fact that many look upon it as wasteful and unsuited for this purpose.

The Bertram shop has found that by paying attention to the angle of the thread on the worm, and getting this steep enough, it makes a good way of transmitting power. The worms shown were cut in very good time and were well done in every way.

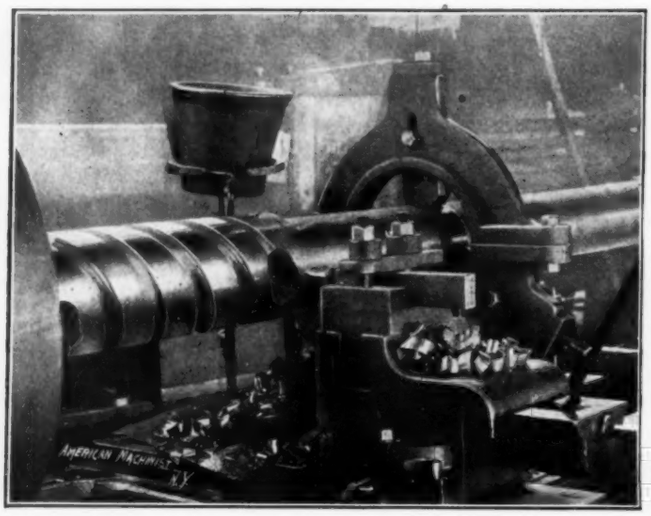


FIG. 1. ROUGHING A TRIPLE-THREAD WORM

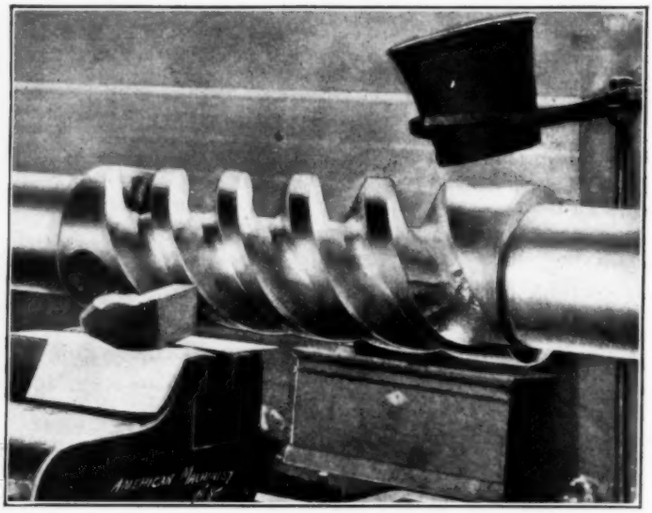


FIG. 2. THE FINISHED WORM AND THE TOOL

Improving Drafting Room System

By E. A. Hart

Although there have been from time to time numerous suggestions in regard to the filing and proper care of drawings, tracings, etc., it still remains in a majority of manufacturing concerns a big question as how to best relieve the delay and inconvenience of a faulty system. It is, indeed, quite an undertaking to have drawings and tracings in such shape that a person can at any time lay his hands on just what he is looking for to print, or for the purpose of changes, etc. It is necessary to have them so filed that at a glance you will know where the particular drawing is at all times. This is almost absolutely necessary in the automobile factory of today, with its hurry for numerous blueprints and the many minor changes, and more important ones too, that must of necessity arise from day to day in the manufacture of a large number of cars per day and in the getting out of new models or special designs.

At the time that I entered the employ of this partioular company, they had all the drawings of the car—that is if you were fortunate enough to find them. It was necessary to have a clerk busy all of the time locating tracings, drawings etc., and then, almost invariably, it was necessary to be on the safe side, to have them checked over before risking making a print and sending it out. This was a very weak system and entirely unnecessary. There were also several different sizes of drawings. We had practically to put on a force of detailers and tracers to redraw and trace on three standard-size sheets nearly all of them. The smallest sheets are details, the next size larger full-size details or layouts, and the largest are the assemblies. What we aimed to do was to have all the essential drawings of the car on the smallest-size sheets placed in a bound book (loose leaf) so that we could have a book in each of the main departments for constant reference. If the drawings were large, we reduced them to a size to use on small sheets.

Units or Groups

We then divided the whole car into groups, or units; for instance, we took the cylinder and put in that group parts related directly to that portion of the car, as valves, valve guides, springs, gaskets, spark plugs, bushings and the standard parts assembled with it such as studs, bolts, nuts, etc. We called this group, group 100. (It is well to mention here that standard parts are given numbers above 1500 and in numerical order according to size.) Returning to our cylinder group, we have a range of numbers from 101 to 139, inclusive, plus the list of actual standard parts that form a portion of this car, which are given their own real numbers and follow No. 139. The next group that we have is the piston group No. 140. (You will note that for the group number we use the number one higher than the last number of the preceding group.) The range of numbers in this group is from 141 to 159 inclusive. We use the group number as the number for the assembly drawing of the group. We aim to show on these assembly drawings each number of the particular group clearly indicated. This serves to fully cover the requirements of the men assembling this portion of the car.

It can be readily seen that we will have a drawer in our cabinet with the letter of the car model (we use letters for our different models), name of group, number of group—which is, of course, also the assembly number—and range of the numbers in the group, without the standard parts, as we put them in drawers by themselves in proper numerical order. This is done because of the fact that the standard parts, being standard, are frequently used on several different models. With this system, we can locate without the least difficulty or loss of time the drawing or tracing desired. We have only to know the part of the car to which the tracing we are searching for belongs or its number to place our hand on it without trouble.

It might be well to state here that no one except the clerk has access to the vault where the cabinet is located. We have blueprinted groups with their standard parts well bound, which the draftsmen draw from the vault when needed and with which they are charged until returned at the close of the day's work. The tracings do not leave the vault except for changes and for the purpose of making blueprints therefrom. We therefore know exactly every moment where our drawings and tracings are. This is a very important point.

Changes

With regard to changes, as soon as a change has been decided upon, I make an entry in a record book I have for that purpose, turn the drawing over to a draftsman for the needed changes and notify a clerk who has a complete card system which enables him at a glance to know where previous prints of this part have been sent. The clerk then arranges for the replacement of all the old prints with new ones, destroys the old prints in the bound books and mounts the new ones on cardboard, shellacked, for factory use, which are not given up until the boy has the old boards to bring back to the engineering department to be destroyed. This avoids that old, familiar and much-abused excuse, "I didn't know it was an old print and thought it was uptodate." The clerk has a system whereby each person receiving a new print has his attention called to it by a note requesting return of old prints, which when received are duly checked off on the card index. The greater part, although not all, of the prints sent to outside concerns doing business for this company are sent direct from the drafting room with blank receipt form attached, which is to be signed and returned. The same system works where the prints are sent to the purchasing department, which, by the way of course, receives copies of all changes together with the general stock department.

Each group in the books are separated by stiff paper leaves on whose margins are indorsed the same information as shown on the cabinet drawers.

Standard parts may be correctly defined as pipe plugs, grease cups, oilers, pet cocks, steel balls, cap screws, bolts, machine screws, cotter pins, studs. The parts are grouped in the order enumerated.

Concise Record of Changes on Each Tracing

That all changes in a tracing may be properly recorded on the tracing, we place in the upper right-hand corner under the caption "Record" each change fully covered in a concise and compact manner, together with the date of the change in question and the draftsman's initials making such change. For instance, if we were to change the number of holes to be drilled in a particular part of the machine from three ½-inch holes to four such holes, we would indicate it (if the first change made in the tracing) on that place on the tracing affected by showing the letter *A*, then we would place under "Record" the following information.

(A) From three ½-inch holes to four ½-inch holes 12 10 1909 E. A. H.

The second change therein would be noted *B*, third *C* and continuing alphabetically as long as needed. We seldom have use for more than four of such entries. Where a change is made in a change, parties are guided by the date of such change in the "Record."

One of the latest utilizations of electricity according to the *Electrical Review* is a novel plan of taking fish from the White river, Indiana, by means of electrical current. A trolley line skirts the river and miscreants tap the trolley wires and then place the other end of the wire into the water. When the wire and current comes near a school of fish they turn up stunned or dead and are taken out of the water with scoops.

OVER-FIRED and UNDER-FIRED HEAT TREATING FURNACES

Water-cooled Front, Self-Contained

BY E. F. LAKE

The proper equipment of a hardening room is one of the most important things in the handling of metals for heat treatment. The main feature of this equipment is the furnaces. With the proper furnaces the temperature can be raised to the point desired, can be maintained at this temperature for any length of time and an even heat can be kept throughout the entire chamber of the furnace. With the proper fuels and valves for regulating this, the temperature desired in the furnace can be raised or lowered as rapidly or as slowly as necessary for the different kinds of work. In the anealing of metals also the rate of cooling can be made as slow as needed if the proper equipment is installed.

Oil-burning Furnaces

The furnaces illustrated and described herewith are of the oil-burning type, but they can be made to burn gases by altering the connections and burners. They are made by the Rockwell Furnace Company, of New York. The adoption of oil for fuel has resulted in a considerable saving in the fuel bill over that of the coal-burning furnaces, and has also made a big improvement in the cleanliness of the hardening room. A more uniform heat can also be secured and maintained throughout the heating chambers of the furnaces using oil or gas than with those using coal for fuel, and the temperature can be brought up to the point desired in quicker time than with coal. The saving in the time consumed by the operator in running the furnace is also an important factor, as when the proper temperature is once obtained and the valves set practically no time is required for this part of the work.

The installation of the furnaces and their necessary equipment is very important for the proper operation of the same, but as this has been described and illustrated in the former article on forges on page 776, Volume 32, Part 2, and as the same installation is the correct thing for these furnaces it will not be gone into further except to add that dry steam at a high pressure will give better results for some classes of work than the air installation shown in the former article. In that case steam pipes take the place of the air pipes and these connect up to the steam supply. To heat steel to a good red 50 pounds oil pressure or 110 pounds steam pressure gives very good results.

Hardening Room

In Fig. 1 is shown a small hardening room that is equipped with two furnaces for ordinary temperatures and one high-speed steel furnace. A pyrometer is shown on the wall to the right and this has connections that make it usable in all three furnaces. Some of the work that is being heat-treated is shown in the lower left-hand corner.

In testing some new furnaces, of the type here shown to the right, that had a chamber 3 feet square, five 20-inch lengths of 2½ inches ground steel were placed on ends in different parts of the furnace so that the uniformity of the heat in the heating chamber could be observed. The temperature was maintained at 1250 degrees Fahrenheit for 1½ hours, after which it was raised to 1400, 1650 and 1960 at equal intervals. At these different temperatures the pyrometer did not show a variation of over 10 degrees and when the test bars were removed they were uniform in color.

Fig. 1. Hardening Room Equipped with Furnaces, Pyrometers and Quenching Baths

Hardening Steel Springs

In hardening some steel coil springs a furnace of this type had the temperature raised to 1600 degrees Fahrenheit, at which point it was maintained without

any variation, according to the pyrometer, except when the door was open. A handful of springs was then charged on a fan, that was used for convenience in handling, inserted in the furnace and submitted to this temperature for one minute after which they were withdrawn and plunged in an oil bath that was maintained at a temperature of 125 degrees Fahrenheit. The furnace was then increased to 1650 degrees Fahrenheit charged with another like quantity and withdrawn after the same length of time. After this a temperature of 1700 degrees Fahrenheit and 1750 degrees Fahrenheit were used in the same manner and each temperature was maintained without any variations.

When removing the springs from the bath the temper was good and the metal was smooth and free from scale, as free from scale as metal could be that had to be exposed to the air in its passage from the furnace to the quenching bath The springs were hardened with oil for fuel and dry steam at 45 pounds pressure for the atomizing agent. Gray smoke that was created before the brickwork became sufficiently heated and a slow heating up of the furnace indicated that a

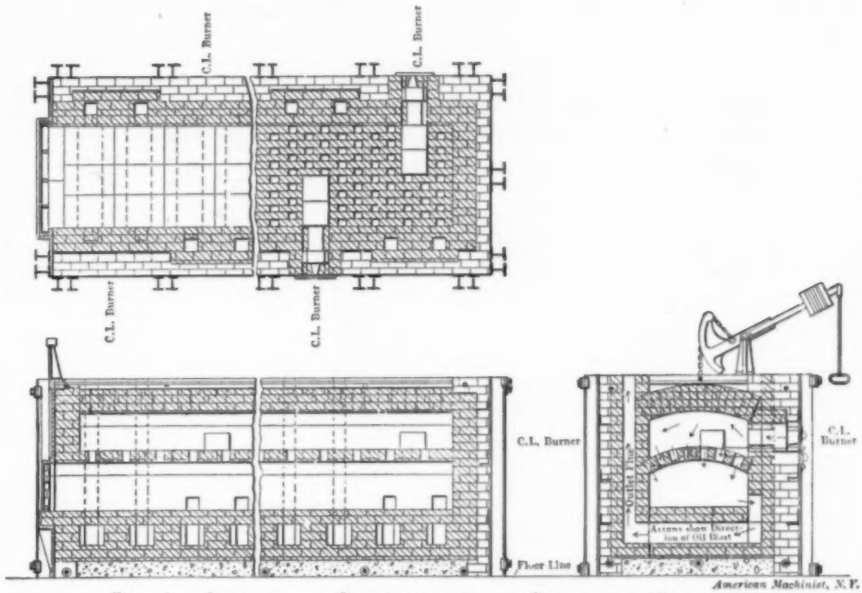


FIG. 3. DETAILS OF CONSTRUCTION OF OVER-FIRED FURNACES

chamber. One method of controlling this is shown by the firebrick on top of the furnace that are attached to a rod with a handle on the end. This is done by covering or uncovering the vent holes on top.

The details of construction of the over-fired type of furnace are shown in Fig. 3. As will be seen an arched roof is built over the heating chamber, the atomized gas from the oil burners being sent into a chamber over this, where they are

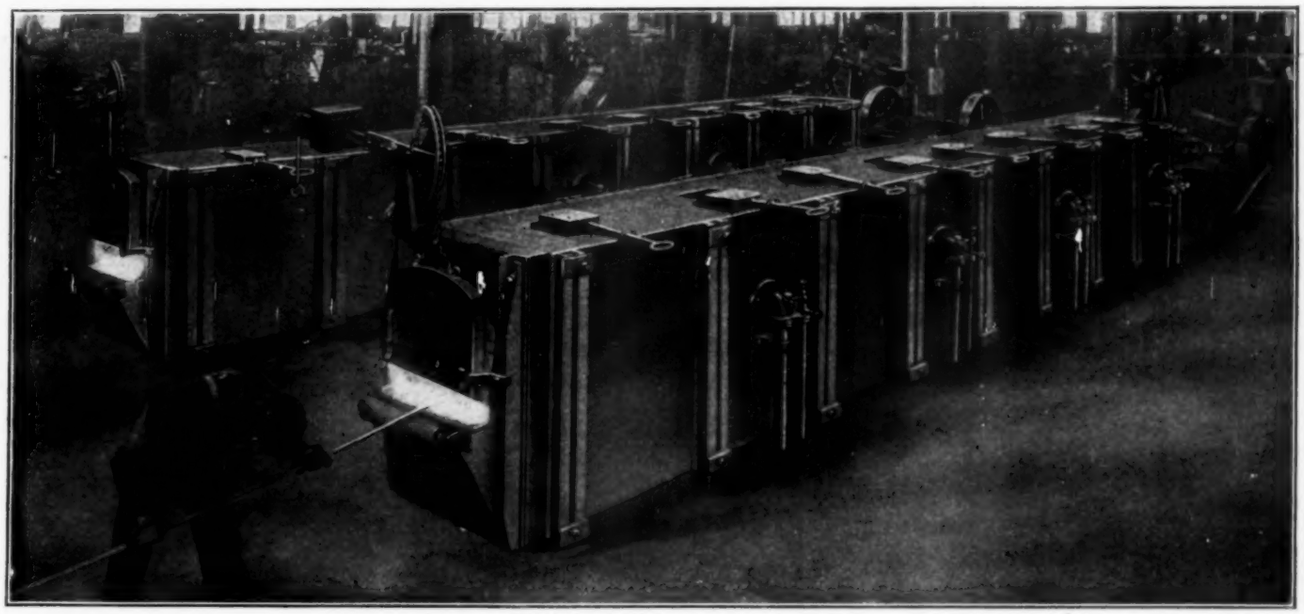


FIG. 2. OVER-FIRED FURNACES HEATING BARS

higher pressure of steam would give better results.

OVER-FIRED FURNACES

These oil furnaces are built in many different styles and sizes and in over-fire and under-fire types. In Fig. 2 are shown two long furnaces of the over-fired type that are being used for heating bars. They have four oil burners on each side of the furnace and an even temperature can be maintained throughout the entire length of the heating

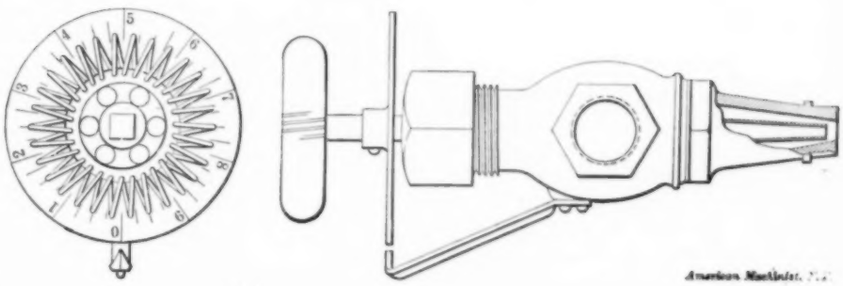


FIG. 4. HIGH-PRESSURE OIL BURNER

burned and passed through numerous openings in the top of the arch, as indicated by the arrows in the right-hand view.

The burned gases are then taken out through holes in the side of the heating chamber close to its floor, and sent under

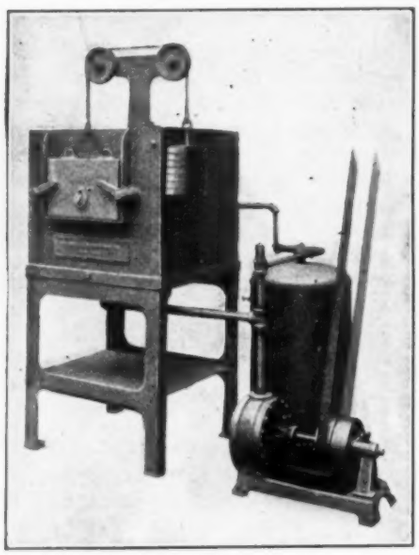


FIG. 5. HEAT-TREATING FURNACE WITH OIL-BURNING OUTFIT

the heating chamber and out through a vent in the top; thus it will be seen that the entire heating chamber is surrounded by the burning fuel. To maintain this temperature at the required point, it is necessary to have a uniform pressure of oil and air and also a burner which can be properly regulated. The pressure for the oil should be 5 pounds or over, and the pressure and volume of the air will vary according to the kind of material heated; this running from about 10 ounces to as many pounds.

BURNER

In Fig. 4 is shown the high-pressure oil burner that is used by this company. The dial with the figures and the pointer at the bottom have been added for fine adjustment. The sectional view at the top shows the method of controlling the volume of atomized oil that is injected into the furnace. It is not advisable to try and make one burner do all kinds of work, and some kind of means should be adopted so the burner can be properly adjusted.

COMPLETE OUTFIT

One of the smaller Rockwell furnaces with a complete oil-burning outfit for hardening, tempering, case-hardening or annealing steel is shown in Fig. 5. This is of the under-fired type and is very useful for the heat treating of small tools, as the right degree of temperature, a uniform saturation of heat and freedom from oxidization or scale are easy to obtain with it.

The details of the construction of the furnace are shown in Fig. 6. The atomized oil enters the furnace in a chamber underneath the heating chamber, where combustion takes place, then the products of combustion go up passages on the side of the heating chamber and enter it at the top, as shown by the arrows in the bottom view. After filling this chamber they leave the furnace at the bottom and pass through flues and out at the top. As with the over-fired furnace the inlet and outlet passages to the heating chamber are alternated on

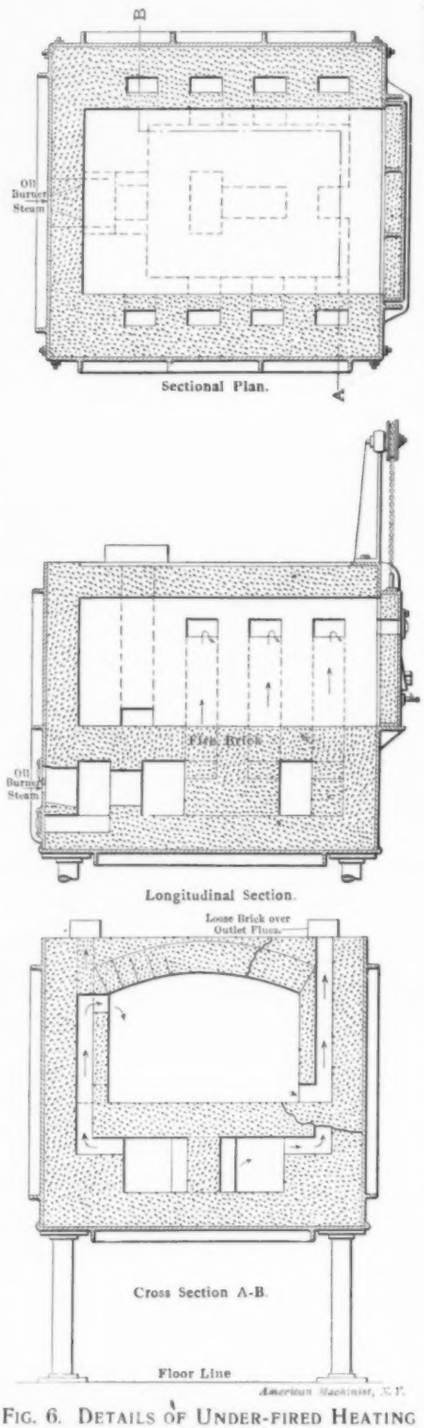


FIG. 6. DETAILS OF UNDER-FIRED HEATING FURNACES

both sides. In this small furnace two of each are placed on each side.

SELF-CONTAINED TOOL FURNACE

In Fig. 7 is shown the latest development of a furnace with oil-burning outfit. In this style the oil-burning outfit

FIG. 7. SELF-CONTAINED HIGH-SPEED STEEL FURNACE

is inclosed in a cylindrical case that supports the furnace, which thus takes up a minimum of floor space. This arrangement enables the oil tank and its necessary apparatus to be placed in the bottom of the case, and thus not be affected by the heat from the furnace; an air space being between the bottom of the furnace and the oil tank. The bottom of the furnace being practically cool, no unduly high temperature is created inside the case. With this furnace a temperature high enough to successfully treat high-speed steel, is readily obtained and the opening of the furnace is high enough to easily handle tools.

WATER-JACKETED FRONT FURNACE

A very useful furnace for heat-treating tools, the end only of which is required to be heated at a very high temperature is shown in Fig. 8. In this a front is inserted that is water jacketed and by keeping a circulation of water passing through it the shank of the tool is kept cool so that it can be easily handled; the heat being confined to the end that projects into the heating chamber.

The water-jacketed front is supplied in different styles with different shapes and sizes of openings that will conform with the user's needs. The openings vary in size from ½x1½ inches to three inches square.

The details of the construction of this furnace are shown in Fig. 9. As will be seen, two burners inject the fuel into

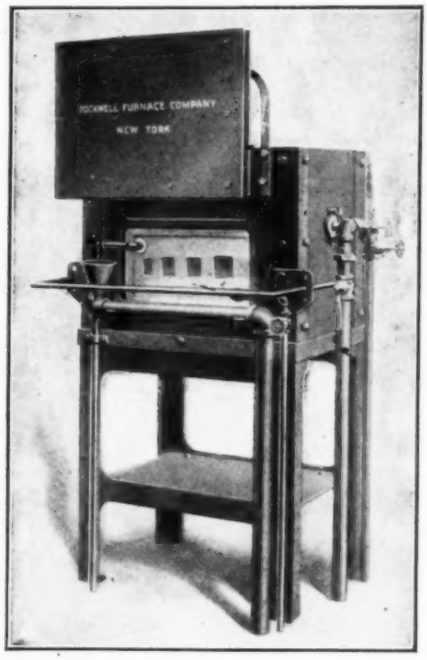


FIG. 8. FORGE FURNACE WITH WATER-COOLED FRONT

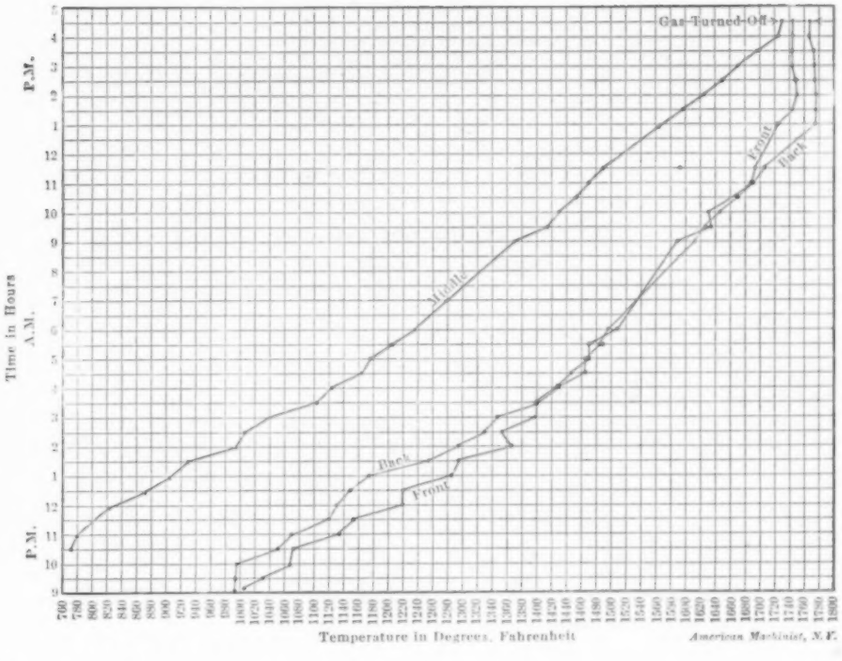


CHART 1. TEMPERATURES OF FURNACE WHILE HEATING ARMATURE LAMINA FOR ANNEALING

opposite sides of the furnace and a double-plated steel shield is placed in front of the opening to protect the operator from the heat, while an air blast comes through the pipe below these openings, and directly beneath them, to drive the heat coming out, up between the shield and furnace.

BARIUM-CHLORIDE FURNACE

The details of a barium-chloride furnace that will hold a number 40 crucible and uses oil for fuel is shown in Fig. 10. This is supplied with an inclosed hood permanently fitted to the furnace, entrance to which is obtained by means of a large door. Through this hood the fumes of the chloride are carried away and the burned gases are taken from the furnace through a pipe up into the top of the hood and thence out the chimney.

CARBONIZING FILAMENTS

An interesting job of carbonizing that was performed with oil-burning furnaces is shown by the electric-lamp filaments after they were carbonized in Fig. 11. These are very weak until they are carbonized. The carbonizing process differs from others in that the temperature must be raised very slowly.

The furnaces are regulated so the temperature will be raised 10 degrees an hour from 200 to 1600 degrees, Fahrenheit, the latter of which is the maximum temperature desired. In the records of one carbonizing heat which I hold it took just 67 hours to attain the required heat.

The furnace was at 200 degrees when the filaments were inserted at 10 o'clock on a certain day and it took until 3 o'clock of the next day to raise the temperature to 400 degrees. Some irregularity was shown during this period, as some hours the increase in temperature was only 5 degrees, while for others it was 10.

From 400 to 1230 degrees Fahrenheit, the pyrometer showed an even raise in temperature of 10 degrees for each hour, and this took a little over 3½ days. From here on the increase was not so important, and the temperature advanced 30 degrees an hour until 1440 degrees were reached and from there to 1600 degrees it advanced 40 degrees an hour.

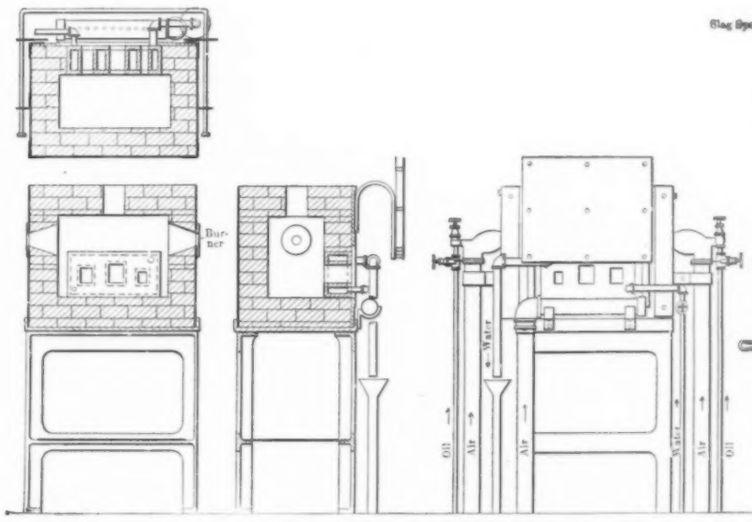


FIG. 9. DETAILS OF FURNACE WITH WATER-JACKETED FRONT

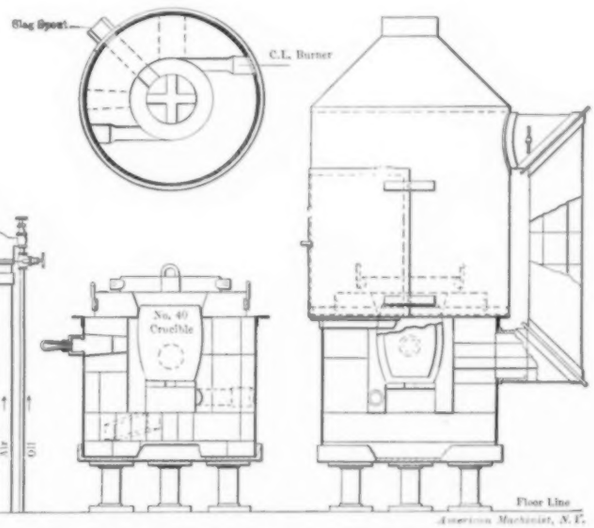


FIG. 10. BARIUM CHLORIDE FURNACE WITH HOOD

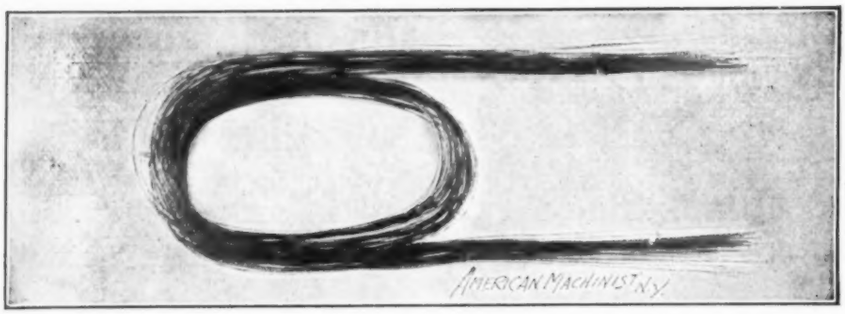


FIG. 11. ELECTRIC-LAMP FILAMENTS AFTER CARBONIZING

CONTROL OF TEMPERATURE FOR A SECOND HEAT

A second heat was started at 200 degrees and the same irregularity, as in the first, occurred up to 400 degrees; that is, the temperature increased 5 degrees some hours and 10 degrees other hours. From 400 to 760 degrees a uniform increase of 10 degrees an hour was made. At this point it jumped 20 degrees in one hour; then the same increase of 10 degrees an hour was shown until 990 degrees was reached. At this point the heat dropped to 970 degrees, a loss of 20, but from here up to 1220 degrees, the records showed the usual 10 degrees an hour increase. From there to 1300 an increase of 20 degrees an hour was made, and from there on the increase was from 30 to 40 degrees an hour until the required 1600 degrees Fahrenheit was reached.

ANNEALING ARMATURE LAMINA

Another interesting job that shows the way the heat can be controlled in these furnaces was the slow heating of some armature lamina that were to be annealed. The sheets were 5x12 feet in size and 36,000 pounds were placed in a box on a car that gave a total weight to be heated of 64,000 pounds. The furnace chamber was 7 feet wide, 14 feet 4 inches long and 9½ feet high. It took 25 hours and 10 minutes to raise the temperature up to 1775 degrees Fahrenheit, when the gas was turned off and the furnace allowed to cool.

In the first 4 hours and 10 minutes, the temperature was raised to about 1000 degrees Fahrenheit and from there on the temperature was taken and recorded every half hour, in the front, middle and back of the furnace, with the exception of a skip of from 6 to 9 o'clock in the morning, and from 11:30 to 1 o'clock at noon. Each thermometer reading that was taken and the time it was taken are shown in chart 1. The dots record the degrees of temperature and the time at which it was taken, and the lines being merely drawn to connect up the temperatures of the front, middle and back of the furnace.

While the temperature was rising there was considerable difference in different parts of the furnace; for instance at 1 a.m., there was a difference of some 380 degrees Fahrenheit; the temperature ranging from 905 to 1283 between the middle and front of the heating chamber. As the heat approached the desired temperature of 1750 degrees, however, it became gradually more uniform throughout the heating chamber. And when the gas was turned off, there was only a difference of about 30 degrees between the middle and back of the furnace, which is a very slight one for such a large heating chamber.

The gas was turned off at 4:30 and at 6:45 the temperature was taken again, at which time it showed a slight increase and only a variation of 9 degrees between the different parts of the furnace. That is, the pyrometer showed the front and middle to be 1769 degrees, while the back was 1778 degrees. From this point on, it gradually cooled. The gas consumed during this run was 98,400 cubic feet; natural gas being the kind used.

Low Priced Men—Ambition in the Shop

By John R. Godfrey

If anyone has any lingering doubts as to the economy of employing efficient men on any work requiring intelligence to even a limited degree, the following incident which is vouched for by the man who was in charge of the work, ought to have some weight.

A new job was let out on contract, and the contractor complained at having lost money on it. So when it came up the second time he promptly made a strike for a higher price. He said he couldn't make it go at the old rate and he had used the lowest-priced men he had in order to keep the cost down, had only used men at $1.75 and he simply couldn't do any better than that.

The superintendent told him the price couldn't be raised and that he believed he could make a profit on the job if he put his best men on it. As he was paying such men $3.25 a day this staggered him. But the super agreed to make good any loss from the contract price if he used the best on the job and the work started.

Much to the surprise of the contractor he came out ahead of the game this time, which was the best kind of an example of the fact that low-priced men are not always cheap and that we must look behind the pay roll and count results as well as the actual money paid out.

No one will argue that a skilled toolmaker should be put on a wheelbarrow job or that it never pays to hire unskilled men. But it often happens that the skilled man can do far more and better work on what we usually consider cheap jobs, than the unskilled man. And we are far more apt to err on the side of employing low-priced men on work that could be done cheaper by men with more skill and at a higher rate.

AMBITION IN THE SHOP

It is a prevalent idea in many places that the shopmen of today do not take the interest in their work that we did in the older days when everything was better, according to some who have forgotten all but the pleasant side of the question. As a matter of fact, however, there is every reason to believe that there is as much ambition and desire to get on as there ever was and, best of all, there are more opportunities now than then.

As an indication of this one can take the experience of any technical or mechanical school which has both day and evening classes, and we find in almost every case that the evening school has the largest attendance and the greatest enthusiasm. In the case of the Franklin Union in Boston, Mass., the evening classes are full, while they do not feel warranted in opening a day class at the present time.

This means that men who are working eight and ten hours a day are not only willing to work two or more evenings a week, but to pay for the privilege, in order to know more about the business they are in, or to learn enough of another trade to make a start in it. This surely cannot be called lack of ambition.

Conditions are changing in many ways and must be recognized. A man who is a single cog in the huge gear train of the larger shops is perhaps apt to wonder if there is any use in trying, the surroundings being different than in the old days. But in spite of the changes, there are as many men anxious to learn as can find the opportunity and we need have no fear of a lack of ambitious men to look after such work as may be necessary.

Making Bottle Mold Templets

By F. R. Manly

Glass bottles are formed from molten glass of which a predetermined amount is gathered on the end of a blow-pipe and introduced into a mold. The mold, which is hinged, is closed and the bottle is formed by blowing air into the glass through the blow-pipe.

Mold Construction

The molds, in which bottles are formed, are made from cast iron. Although there are different designs for different classes of glass-ware, the common type of bottle mold is constructed as shown in Fig. 1. It consists of two halves hinged at *A* and a bottom-plate *B* upon which the halves rest.

The molds are worked out to templets. Methods of figuring dimensions and laying out a templet for a mold that will produce a bottle of a given shape, weight and capacity may be of interest to some. Although these methods are simple and require only an elementary knowledge of mathematics, they are little understood by the average moldmaker; consequently templet cutting is in many instances largely a case of cut and try. Such inaccurate methods are often the cause of costly mistakes: the bottle produced by the finished mold is either too large or too small.

A Specific Example

To illustrate the correct method of originating a templet, let it be desired to produce a bottle similar to a given sample but of a different specified capacity and weight. For example: given a bottle, as shown at *A*, Fig. 2, which weighs 3 ounces and holds 3 ounces (by volume), to produce a bottle similar to it in every respect but weighing 4½ ounces and holding 5 ounces. The first step would be to determine the displacements of the sample and of the bottle required. By displacement is meant the volume of the bottle if considered as a solid.

Bottle Displacement

To obtain the displacement of a bottle, multiply the weight by 0.38 (1 ounce of bottle glass by weight is approximately equal to 0.38 ounce by volume) and add the capacity. The displacement of the sample would be $(0.38 \times 3) + 3 = 4.14$ ounces. The displacement of the bottle required would be $(0.38 \times 4.5) + 5 = 6.7$ ounces.

From the displacements thus secured, the various dimensions of the required bottle may be figured from the following rule. If U and U' represent two similar solids, and n and n' two homologous dimensions upon these solids, then

$$\sqrt[3]{U} : \sqrt[3]{U'} :: n : n'.$$

The applicability of this rule will readily be seen. The displacements of the sample and of the bottle required, are the volumes of similar solids. Hence, since U may represent the displacement of *A*, and U' the displacement of *B*, then

$$\sqrt[3]{4.14} : \sqrt[3]{6.7} :: n : x.$$

x will have a value equal to n' which is the homologous dimension sought.

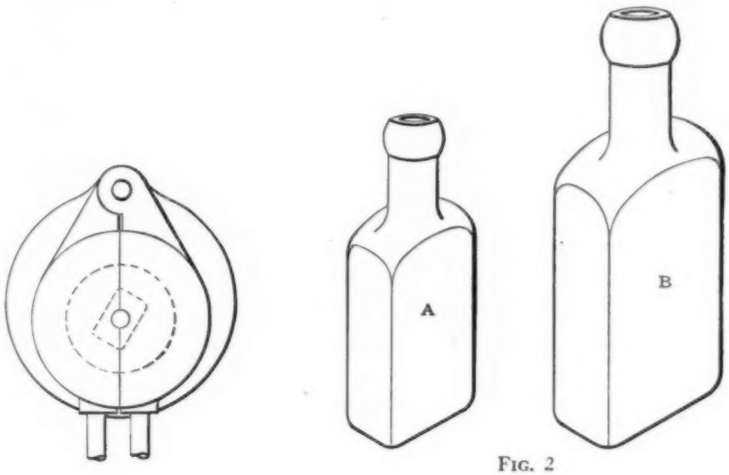


Fig. 2

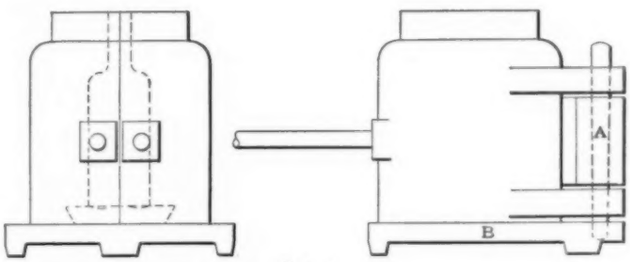


Fig. 1

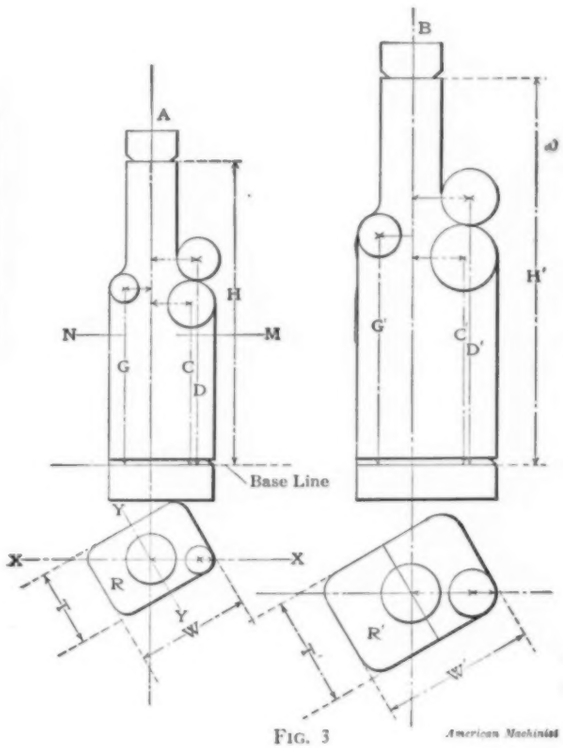


Fig. 3

Making Bottle-mold Templets

The Drawing of the Sample Bottle

A pencil drawing of the sample bottle is next made. *A*, Fig. 3, shows the views necessary. *R* is a right section of the bottle. Line *x*—*x* represents the parting plane of the mold.

M is a corner profile and lies in the plane *x*—*x*. *N* is a side profile and lies in *y*—*y*. The curves of the bottle are transferred to the drawing by means of wood templets which are fitted to the various profiles.

The drawing of the sample having been laid out, the next step is to find the location of the centers and the lengths of the radii of the different curves. This is done by trial with a pair of dividers. The distances of these centers from the base and center lines are then noted upon the

drawing. In Fig. 3, the various dimensions are represented by letters.

The Sheet Metal Templet

The drawing of the sample having been completed and the cube roots of the two displacements extracted, the templet for the bottle required may be started. Bottle-mold templets may be made from sheet tin or lead plate, the latter being preferable because it is not so bright as tin. The material from which the templet is to be cut, is clamped to a special cast-iron surface plate which is provided with a T-square. Center lines and a base line are drawn, by the use of a scriber, and upon these lines is constructed a drawing similar in every respect to that of the sample but whose homologous dimensions are those of the bottle required; these dimensions as I have shown are figured thus:

$$\sqrt[3]{4.14} : \sqrt[3]{6.7} :: H : H' :: D : D' :: C : C' \ldots\ldots$$

For solving these proportions a slide-rule is very convenient.

The templet, having been laid out, is next cut from the sheet and filed up. The parts are then stamped with the name, size, and weight of the bottle they are to produce. A hole is punched in the two parts which are then tied together; the templet is then ready for use.

Electric Mud and What Came of It *By E. A. Dixie*

Some years ago, when electricity was in its infancy and the terms "electric" and "electrical" were used more extensively than now to conjure cash out of the pockets of a trusting and gullible public, there blew into San Francisco and registered at the Palace hotel, a shrewd, well dressed man whose card, besides half the letters of the alphabet following his name, bore the magic words "electrical engineer and lecturer on electricity at so-and-so, etc."—all foreign universities of note.

He was a very busy man. During the day one of the swellest equipages in the Palace's palatial stables took him for long drives in the country, and in the evening his suite of rooms in the Palace was filled with moneyed men.

One of the rooms was fitted up as a laboratory, equipped with many strange electrical appliances. Along one wall, arranged on a series of shelves were numbers of glass jars filled three-quarters full with a black pasty looking substance. Each jar had a lid through which two rods stuck. One of these was of whitish metal, while the other was similar in color to copper. Wires led from the tops of the rods, the copper-colored rod in one jar being connected by a wire to the whitish rod in the next, and so on through the whole series. The wire from the copper-colored rod in the first jar and from the whitish rod in the last jar led down to a cylindrical device on a polished mahogany stand.

One evening, a couple of weeks after his arrival in town, the professor announced that as a special favor he would allow the chosen few, then with him in his rooms, to witness one of the greatest developments in cheap electrical power the world had ever known.

Previous to this he had never taken any of them into the laboratory, but had studiously left the door slightly open so that they could see the wires, fancy brass fittings, etc., and see and hear the sparks from a static machine.

"Before going into the laboratory, gentlemen, I want to tell you what I have been doing in the past two weeks.

"We poor scientists blaze the trail for you capitalists, you reap what we sow.

"You ask why do I not profit by my knowledge; and I say to you because I can't, because I'm not built that way, because I am no business man. As long as I can get a few paltry dollars to pay for further experiments and to develop money-making possibilities for others I am satisfied. Wealth I have no use for and do not desire. Being a man without kith or kin, my beloved science is everything to me.

"Three years ago, while busy investigating terrestrial magnetism, my attention was called to the local errors occurring in ship's compasses, on the coast of California, which many times resulted in disasters.

"My friend Lord Knowswho, first Lord of the Admiralty of Great Britain, was also deeply interested in the subject, owing to the fact that several British ships had been wrecked near here. He called on me one day in Zurich. Our interview will not interest you but his final words were, 'Watson, find the cause of these local magnetic disturbances on the Californian coast near San Francisco and you can count on me for expenses to the amount of £1000 per annum till you find it.'

"Of course I told him that as an honest man I could not guarantee to find anything, but he replied:

"'Watson, you are the foremost authority on magnetism and electricity the world has ever known and if you give your word that you will *try* to find it I am satisfied the job is as good as done.' He said other things but modesty forbids that I should repeat them. I gave him my promise, and investigated what I could from time to time when my other work would permit.

"With the perfecting of my mariner's compass, which is now being manufactured in Scotland under patents granted to another, my work in Europe was finished, so I came here to study the proposition on the ground. Before coming I declined many offers of large sums of money, to remain and take up other work but my word had been passed to Lord Knowswho and besides the work itself was very alluring to me.

"I have found the cause of these magnetic disturbances and further than that I have found a practically unlimited nature's storehouse of electric power which can be tapped and will supply millions of horsepower of electricity at absolutely no cost at all except for equipment.

"During the past two weeks I have been very busy, first tracing down my scientific deductions, which would probably not interest you, except that I suspected a concentration of the earth's magnetism at a point near San Francisco. I have found that magnetic area, I have surveyed it and now have an option on all the ground comprising it."

Watson then showed them (to their satisfaction) by means of a magneto that electricity and magnetism are the same thing; he then ushered them into the laboratory with its rows of jars.

"These are, as you see, plain glass fruit jars. They are filled three-quarters full of electric mud taken from the land on the Oakland side of the bay and on which I hold an option. I have here two wires to which brass handles are attached and here is a switch which controls the electric current.

"I showed you with the magneto how magnetism and electricity are the same. I will now apply the same infallible tests to this mud."

He then passed the current through a coil of wire and moved a compass back and forth showing how the needle was influenced. One of the rods was then lifted from one of the jars and the circuit broken. It was pointed out to them that under this condition the compass was not affected. The circuit was then again made perfect.

"Now I am going to allow this current to pass through my body. Will one of you gentlemen please throw that switch?"

Watson grasped the handles and the switch was thrown while the onlookers gazed at him in horror, expecting to see him collapse.

"I have as you see used very small wires. More water will pass through a large pipe than through a small one. The same condition holds good for electricity, more will pass through a large wire than through a small one. I have for that reason used small wires. If I were to use large wires enough electricity would pass through them to cre-

mate a man. Will one of you test the current?"

One after the other tried the current which coming through the cylindrical instrument (a common shocking coil) caused them to jump.

"Wonderful, marvelous" and similar ejaculations were heard on every hand.

"I have an option on 20,000 acres of electric mud. I have tested it to a depth of fifteen feet and if anything the lower strata contain more electricity than the surface, owing to the well known fact that by contact with the atmosphere the electricity on the surface has become oxidized and in that condition is more easily dissociated. With this 20,000 acres we can supply light and power to the country for a hundred miles in any direction. Tomorrow morning I will take any of you, who wish, to see this property and I will give a test on the ground."

With one accord the capitalists signified their intention of being with the party.

Next morning early a big omnibus drove from the Palace hotel. In it were the capitalists and Professor Watson. Behind the omnibus came a wagon loaded with electrical appliances. Once over the ferry the party went to the mud flats along the bay, where the professor showed them the poles marking the confines of the marsh land on which he had an option. When the party had stepped out of the vehicle Professor Watson produced a compass and holding it near the ground called their attention to the erratic behavior of the needle. He then shouted to the man in the wagon:

"Jones, drive a zinc in here and a copper there."

This was repeated at several places, the zincs and coppers connected and a wire run to the shocking coil.

"Now gentlemen, who wants to feel the electricity?"

One after the other tried it and was much impressed. By this time the tide was making the ground soppy under foot so off they went to San Francisco, very much influenced by the marvelous force imprisoned in the 20,000 acres of electric mud and its money-making possibilities.

The afternoon was a busy one. Papers were drawn for the new company, money was subscribed for stock and it was suggested that the professor go East at once to buy the necessary equipment, which could not be obtained on the Pacific coast.

The next day Professor Watson took his departure on the limited express. By a strange coincidence Jones, who drove the wagon with the electrical appliances, had a chair in a remote part of the same train.

When they met later in the dining car Jones said to the professor:

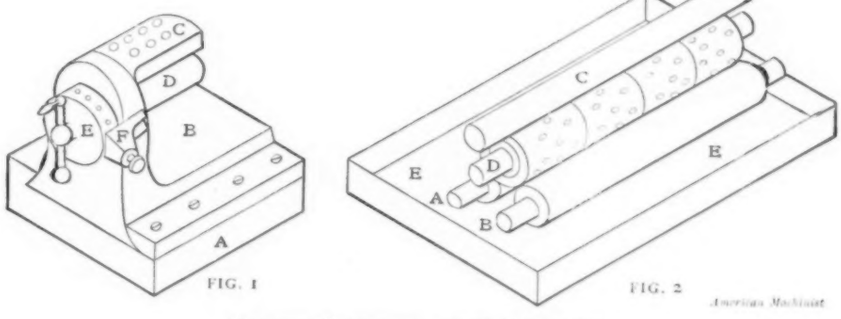
"How much did you clean up, Reddy?"

"Twenty six thousand, all in bills in the grip. We'll change cars in a little while and make tracks for Mexico. What's the matter with your hand, Mike?"

"I spilt a little sulphuric acid on it yesterday morning in the dark when I was salting that electricity mine of yours over at the mud flats. Were those chunks of pig iron I buried large enough to attract the compass?"

Making Graphite Filled Bushings

In the making of a certain class of machinery, a large number of brass bushings were used for bearings which had to stand up under rather severe work, and continuous or even frequent oiling could not be depended upon. So it was decided to drill these with a number of holes, and fill the holes with a composition of graphite in order to make the bearings self-lubricating.



MAKING GRAPHITE-FILLED BUSHINGS

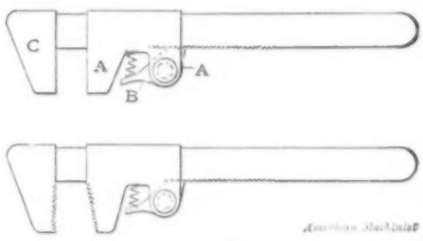
After these bushings were turned and bored, they were placed on the arbor *D* of the drilling fixture, shown in Fig. 1, which was mounted on the drill-press table. This consists of a base *A* and a sliding head *B* carrying the stud *D* and the jig plate *C*. With a bushing in place on stud *D*, a row of four holes is drilled by moving the head *B* along for each hole. Then the stud *D*, carrying the bushing, is indexed by *E* and *F*, and the jig plate *C* swung to the left to bring the line of three holes in the center. After these are drilled it is again indexed, and the jig plate swung back to the four-hole position as the holes alternate between three and four to the row. By this means the holes in a bushing can be quickly drilled by a boy and the bushings are then ready to be filled with the graphite.

For this purpose they are taken to a little machine, shown in outline in Fig. 2, in which only the rolls are indicated and all framework omitted. A string of the bushings are put on the arbor *S* which slips into place between the three rolls *A*, *B* and *C*, the whole thing being mounted over a steam-heated pan *E*. This pan contains a mixture of paraffin and graphite, just enough paraffin being used to form a bond for the graphite. This is thoroughly mixed together while warm from the steam below *E*, and the mixture is spread along the top of the roller which is rolling toward the bushings on the arbor *D*. These rollers turn slowly, being driven by a small belt, and the lubricating mixture is forced into the holes already drilled in these bushings. In this way it is an easy matter to fill these holes solidly with the mixture of graphite and paraffin, and the results are said to be perfectly satisfactory in every way. This method is in use in the shop of the Dobbie Foundry and Machine Company, Niagara Falls, N. Y.

Design for Handy Wrench

BY G. A. BEAUDRY

This design of wrench is very quickly adjusted to the size required, either forward or backward.



A HANDY WRENCH

Few explanations are needed. Take hold of *C* in the left hand while the right hand takes hold of the handle, then a slight pressure of the thumb of the right hand on *B*, releases the rack. Then the sliding jaw can be slid back the full length of the handle in a second. To slide it forward you apply your thumb on *A A* and the jaw will move forward at any point you wish.

Crank Shapers—Automobile Repairs

By Frank C. Hudson

The crank shaper seems to be a case of designing and building much better than we knew, in the light of later developments in the planer field.

If we can believe half of what we hear and a part of what we see, there seems to be little doubt that a planer tool will stand up better and cut faster by striking into the work slowly and then speeding up after it is buried in the cut. We hear of runs where the tool strikes the work at the usual speed of, say, 40 feet a minute and then the work speeds up to 80 or even 120 feet, slowing down to 40 feet again at the end of the stroke. And the tool stands the racket.

The funny part of the whole thing is that is just what we have been trying to get away from in building shapers. The old crank shaper starts into a cut at slow speed, increases toward the center and then slow, down again. To avoid this lack of uniformity in the speed of travel, varied and ingenious devices have been used to even it up and make it approach a planer in its steadiness of stroke. See various advertisements from time to time to this effect; and all the time we didn't want anything of the kind, only we didn't know it. The slow start into the cut seems reasonable in every way and if it is good in a planer it is equally good or better on a shaper, and the beauty of it is, we can get it easier than we can avoid it.

The shaper men ought to use this point for all it is worth for it has more to it than some of the points we often hear talked about.

Automobile Repairs

There seems to be a trend toward better things in automobile repairing for which owners of cars should be duly thankful. Time was, and is in too many cases, when an automobile repair man need only have a smattering of alleged knowledge about gas engines. He could talk learnedly about fat and lean sparks, about rich and poor mixtures, but preferred to loosen nuts with a cold chisel and a hammer to using a wrench. And no bearing cap was ever tight enough until he couldn't tighten it any more.

But real machinists are getting into the business these days, men who are machinists first and gas-engine men afterward, and the change is decidedly for the better. And some of them are really training men in the way they should go, for which the automobile owners should be devoutly thankful. It's a special branch of the business that has much to recommend it, as it is interesting to most of us, it has more variety than many lines of machine work and it gives an insight into a number of things that should prove helpful to any machinist.

A Nice Business Without Details

By R. E. Marks

He was an intelligent-looking gentleman with good clothes and a sorrowful mein, and he stood looking for a long time watching the assembling of a large machine, from the gallery above. He was so interested that I asked him if I could explain anything to him and he was delighted to know all about the business.

So I took him to the drawing room, showed him the first rough drafts of a machine to do any special work that was required; the drawings of the machines, both in assembly and in detail; how these went to the pattern shop and the patterns to the foundry.

Then we started in on the castings as they arrived; followed them to the planers, milling machines, lathes and other tools; saw the making of the gears, shafts and screws and finally arrived at the erecting floor, where the parts were being assembled.

"Wonderful, wonderful," he said. "You make a few drawings and patterns, the castings come in and are machined, then they are assembled. Everything is so orderly and goes through without a hitch.

"What a fine business to be in. Must be a pleasure to you. I certainly wish I had a business that went along like that with practically no details to look after."

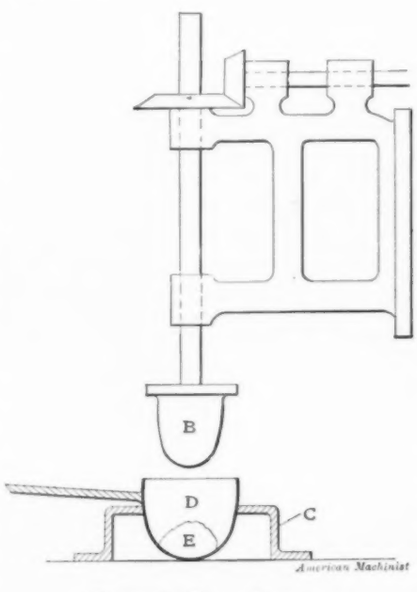
This sort of paralyzed me because I had always been under the delusion that we had a little million details and then some. So I wondered what his line could be—and asked him.

"Me? Oh, I'm a life-insurance solicitor."

He had departed before I came to or I might have been tempted to ask just how his line of work had so many more details than my own.

Daubing Foundry Hand Ladles

In a certain large cast-iron soil-pipe foundry, where it formerly kept three men busy "daubing" ladles, the superintendent has introduced a cheap machine to do the work so that now one man can in one hour daub all the ladles required for the day's work.



Daubing Hand Ladles

The cut shows the device. An old fashioned drill press was bought second hand. The spindle has a travel of about 13 inches and is provided with a simple lever feed, not shown. To the end of the lever the turned cast-iron former *B* is fastened. This former is made the shape of the inside of the finished daubed ladle. The spindle and former are counterbored. A roughly made iron centering device *C*, centers the ladle *D*. A "hunk" of loam *E* is put in the bottom of the ladle and the quickly rotating former is brought down against it. The surplus loam is forced up the sides and over the edge. The finished daubed ladles are much neater in appearance as the work is more uniform than hand daubing.

Borax Flux for Hard Solder

According to an English contemporary, an improved borax flux for hard solder has recently been patented by a Berlin inventor. It is made by heating three parts of ordinary crystal borax and one part of boracic acid together so that the whole gently melts into a clear, thick syrup. The flux is used in this condition, and is not dried. The advantage claimed for such a flux is that it will remain a long time without drying, and is easily applied to the surface to be soldered, and to which it firmly adheres, so that when the blowpipe is applied it will not be blown off. In addition, it is easily removed after soldering, as it usually cracks off of its own accord, and if not, may be readily washed off. It is also claimed that the flux does not swell like crystal borax, but fuses down at once to a clear glass.

INTERESTING METHODS in a CANADIAN SHOP

Making Large Gears, Racks, Worms, Etc.

BY FRED H. COLVIN

In the shop of John Bertram & Son, Dundas, Ontario, Canada, are some very interesting methods, used in connection with their work of building all kinds of machine tools. Some of these are shown herewith, through the courtesy of James Bertram, manager of the works.

Rack Cutting on a Shaper

An interesting method of cutting racks is illustrated in Fig. 1, in which a shaper with a traversing head is utilized for the purpose. An auxiliary table is used for holding the racks to be cut, and a large index wheel is placed on the traversing screw so that very accurate spacing can be easily obtained.

The most interesting part of the work is the tool and tool holder used. The tool holder takes the place of the usual clapper block and swings from the same point, being lifted out of the work and held during the return stroke by the spring at the top. In order to hold the tools rigidly during the cut, the cam *A* is used, operated by the arm *B*, through the rod *C*, which is controlled by the two collars striking the stationary support at the end of the stroke. In this way the cam is automatically forced against the upper end of the tool holder, supporting it rigidly during the cut and is automatically withdrawn just before the return stroke. The tool is fed down to a positive stop and a good rack secured in this way.

A multiple cutting tool is used, as can be seen in both illustrations, each tooth being relieved so that all the teeth do not cut to the full depth but each takes a chip in the same way as in broaching. It has been found advantageous to use fewer teeth than indicated in Fig. 2 and to grind a rake on the cutting edge of each tooth. This is alternated to equalize the side thrust when these are in the cut and the result is an extremely good cutting action which allows the teeth to be planed quite rapidly. In the illustration shown a wide plate rack is being made, but narrow racks can be clamped together and cut as in any other machine.

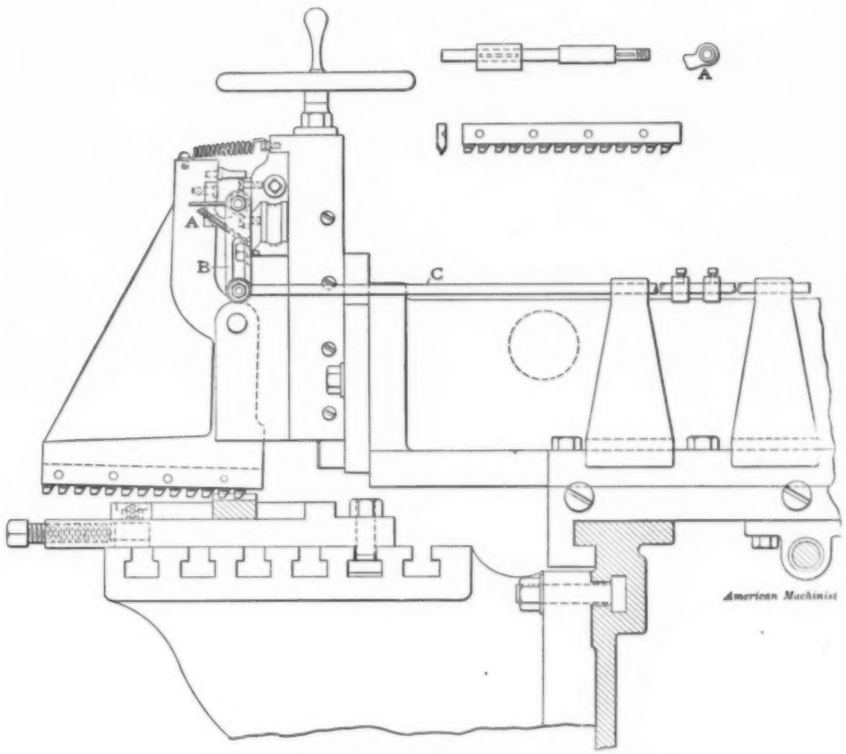


Fig. 2. Details of Rack-cutting Device

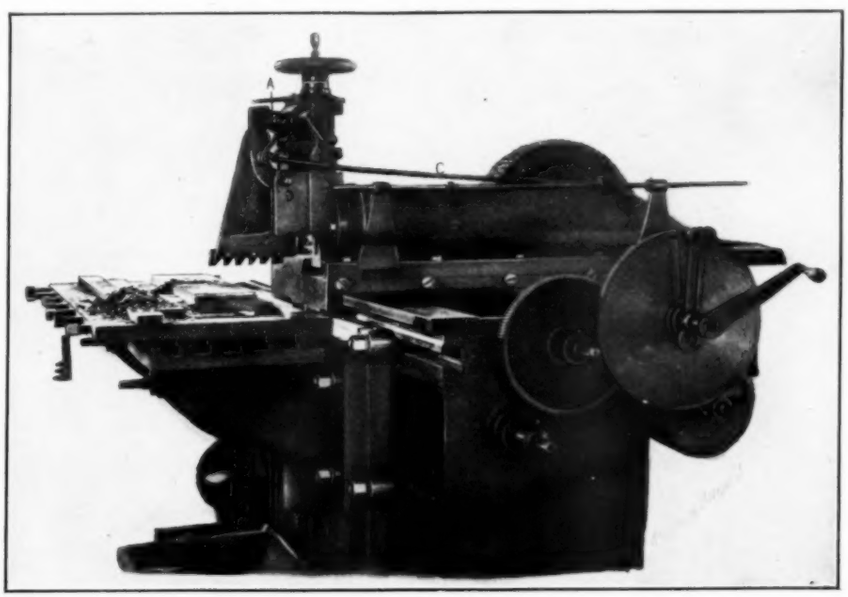


Fig. 1. Cutting Racks on a Shaper

Cutting Large Gears on a Slotter

Fig. 3 shows a large slotter at work on a good-sized gear and having nearly completed the finishing cut. The roughing tool with its stepped edges is shown on the machine, together with a finishing tool which has been ground hollow on top to give a better cutting edge.

The feed mechanism which moves the work toward the tool is shown in the lower right-hand corner and is provided with an ingenious device for automatically preventing the tooth being cut too deep. The wheel *A* is a visible indicator and is convenient for setting the machine and shows the operator from a distance the position of the feed. Next to this wheel is a pinion which meshes into gear *B* and this has an annular T-slot on one side, carrying the stud *C*. When this is properly located it strikes the arm *D*

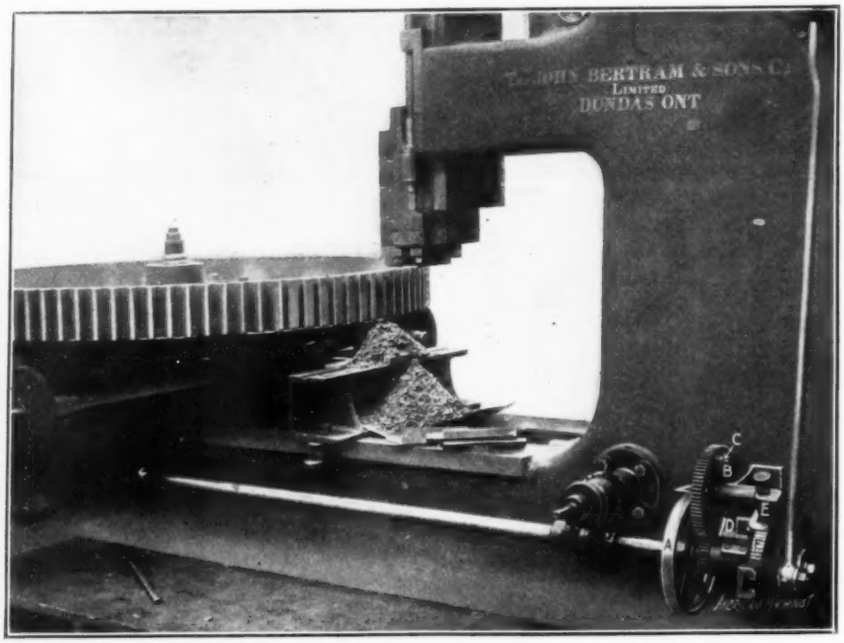


FIG. 3. CUTTING LARGE GEARS ON A SLOTTER

which controls the shield *E* and automatically moves this shield so as to cover the notches in the feed wheel *F*, and preventing all further movement of the feed screw.

Fig. 4 shows the arrangement of the tool blocks in the ram so as to insure

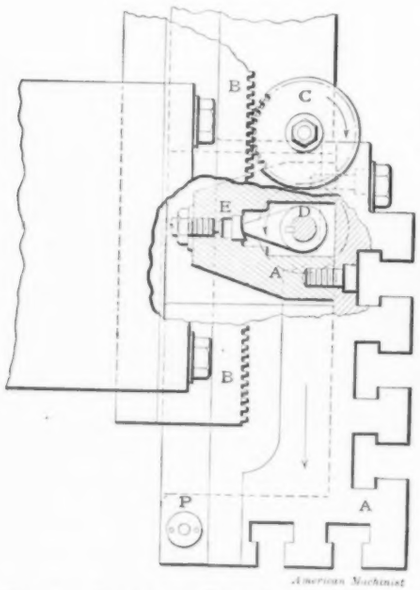


FIG. 4. DETAIL OF TOOL LIFTING APRON

its being held rigidly in position during the cutting stroke. The tool block *A* is pivoted at *P* and at the upper end has an extension surrounding the cam *D*. The rack *B* is fixed on the side of the ram support and in this the gear *C*, mounted on a stud in the ram itself, gives motion to a gear which drives the cam shaft *D* by friction washers, so that it can slip after the cam *D* has been forced into place.

As the ram starts down, the gear *C* turns in the direction of the arrow and drives the gear on *D* in the opposite direction, throwing the point of the cam against the hardened incline block *E*, which forces the upper end of the tool block solidly against the ram and insures the cutting tool being held in its proper position during the cut.

As soon as the ram starts to return the cam *D* is thrown up, allowing the upper end of the tool block to be forced out by a powerful spring and so relieve the tool on the return stroke. The block *E* can be readily adjusted by the screw at the back so as to secure just the desired clamping effect.

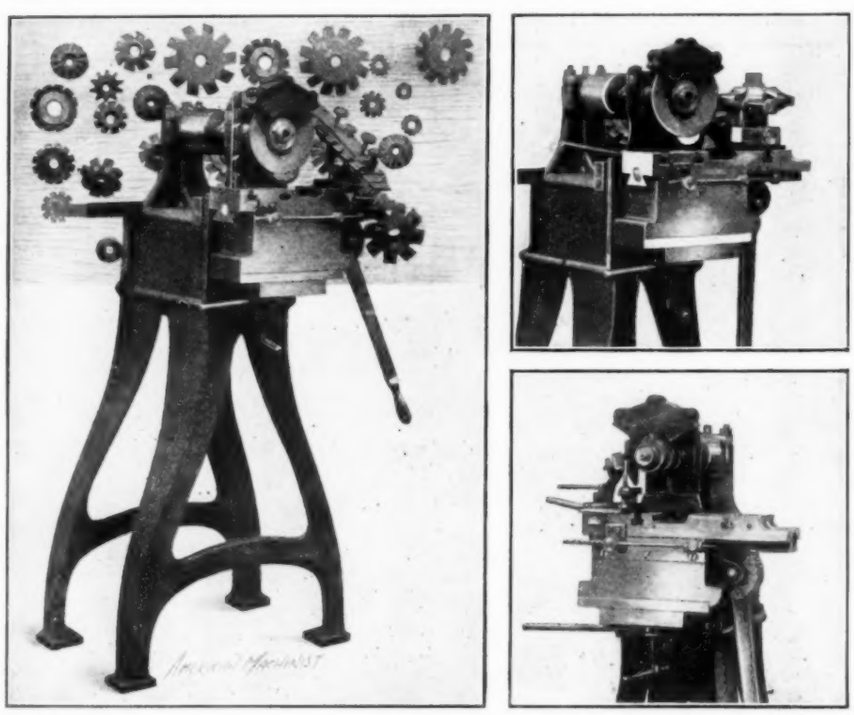
A CONVENIENT CUTTER GRINDER

Fig. 5 shows a very convenient cutter grinder built by the toolmaker for his own use. This shows how it is used on the rack-cutting tool, which gives a good idea of the appearance of these tools. The one shown standing on end to the left of the grinding wheel, shows just how those cutters are ground. The machine has lever feed, easily adjustable stops and is very convenient to operate.

Fig. 6 shows how it is used in grinding small cutters, and Fig. 7 the fixture for holding face cutters. In each case the cutters can be ground very rapidly. The cutter board behind the machine gives a good idea of the large variety of work that can be ground by it.

A Novel Locomotive

An interesting and unique locomotive has recently been built in France for the Garrat railway in Tasmania. It is a compound locomotive with the cylinders mounted on separate trucks, one at each end, one carrying water and the other coal. The boiler with its smokestack, dome, cab, etc., is mounted so that one end rests on each truck. This makes a very flexible wheel base, but introduces ball joints for each pair of cylinders. When it comes to novelties in the locomotive line France is usually several laps ahead of the United States, which may or may not be to her credit.

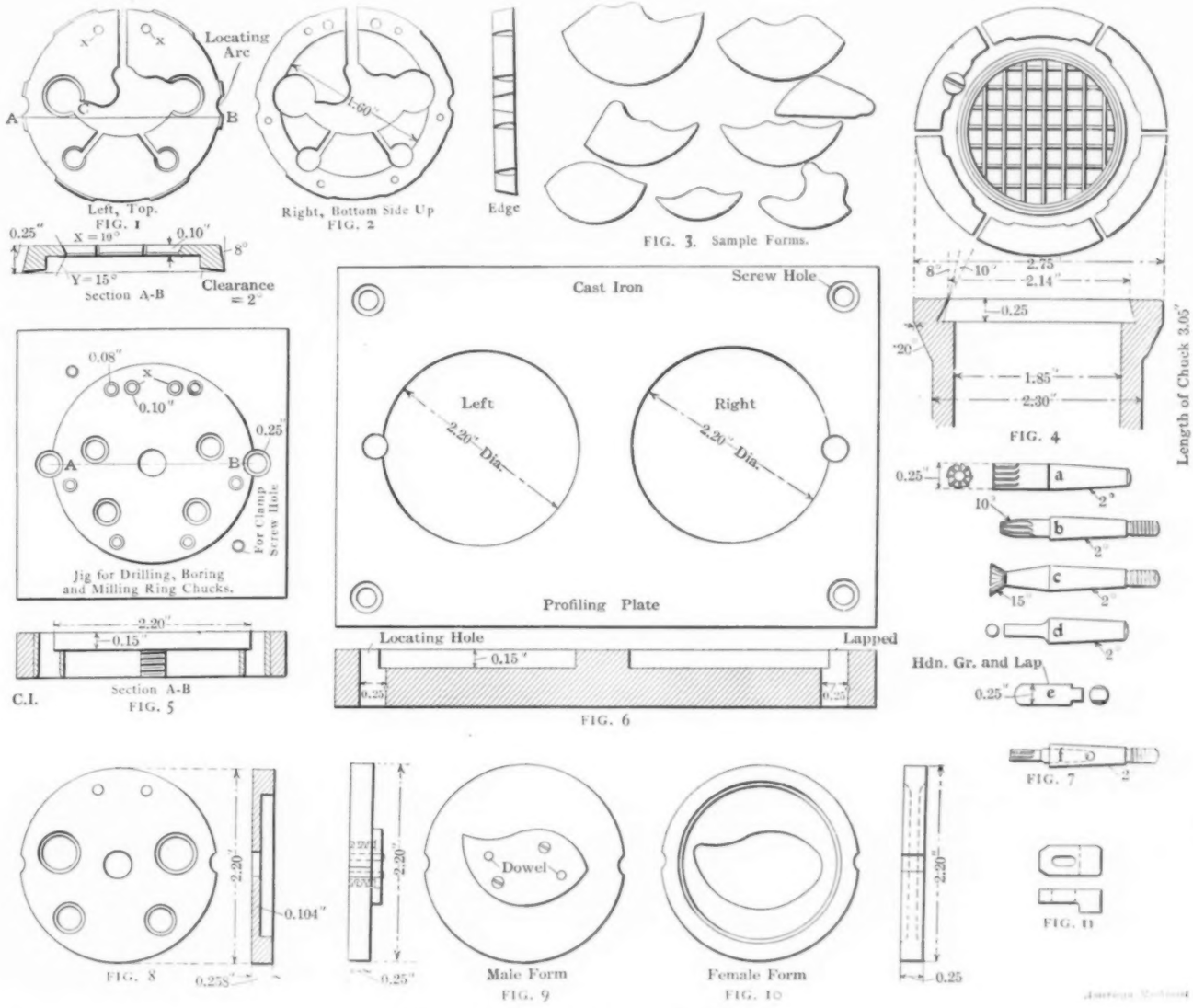


FIGS. 5, 6, 7. A HOMEMADE TOOL GRINDER AND ITS WORK.

Making Ring Chucks for Watch Work

By G. Haessler

In Figs. 1 and 2 are views of a type of ring chuck which is one of 256, consisting of 16 sets (8 right and 8 left) of various shapes. Some of these are indicated by the sample forms, Fig. 3. Fig. 1 represents the top and section of one of the lefts, assuming this to be left on account of the narrow end *C* being on the left. Fig. 2 shows the bottom and edge of one of the rights. A section across *A B*, Fig. 1, is shown exposing the two angles *X Y*. Before hardening these rings they were spread by inserting a piece of metal in the slot *B*, Fig. 1, and then wired. Both sides and the diameter were then ground.



MAKING RING CHUCKS FOR WATCH WORK

How the Rings Are Used

When in use they are set in the spring chuck, Fig. 4. To locate the ring within this chuck a special tool is used to contract it by means of the two holes *x x*, Fig. 1, until its segments clear the corresponding recesses in the spring chuck. The ring is then turned until the surfaces of both ring and chuck have full contact, when it is released and secured by means of the screw shown. Eight of these chucks, Fig. 4, are located in the machine forming a circle and each one with its ring carrying a blank like one of the sample forms, Fig. 3, passes under a special cutter which, with one sweep finishes one side of the blank flat.

Modifications Necessary

Some of these rings were made omitting the angles *X Y*, Fig. 1. That is, this part was left square with the top and bottom of the ring. As a result the work was not held securely and tilted up from the anvil, the face of which, with its grooved surface is shown in Fig. 4, and consequently the work would not come parallel. To overcome this difficulty the two angles *X Y* were profiled in; also, instead of making the outside angle or bevel of the rings the same as in the chuck the latter was changed, as shown in section, Fig. 4, by the extended line. These alterations secured the desired results by causing the forcing down of the work on the anvil.

To get this work out, the jig, Fig. 5, profiling plate, Fig. 6, and tools in Fig. 7, were used. Long pieces of stock were turned and ground accurately to the diameter of the recess in scales, Figs. 5 and 6. The stock was then cut off, faced and recessed as in Fig. 1 and Fig. 8, some being reserved for the forms, Figs. 9 and 10.

The Profiling Operations on the Formers

The male form, Fig. 9, consisted

simply of a blank punching with its edge smoothed off, screwed and doweled in place, as shown in Fig. 9. The female forms were recessed on both sides as indicated by dotted lines, Fig. 10, thus making them reversible and adapted for right and left rings. The outlines of these female forms were obtained in the profiler, then drilled and filed approximately, when they were replaced in the left-hand recess of the profiling plate, Fig. 6, which was screwed on the profiler bed. The form blanks were located with pin *e*, Fig. 7 (which was just tapped in and removed with pliers), then clamped with two small clamps, Fig. 11. The male forms were located in the right-hand recess in the same manner.

By throwing off the belt from the right-hand spindle of the profiler with the pilot *d*, Fig. 7, in this spindle and cutter *f*, Fig. 7, in the other, then grasping the two handles of the profiler and keeping the pilot in contact with the male form the female was finished. All were made in this way, using a smaller cutter where necessary.

Jigging the Ring Blanks

The blanks for the rings were drilled and bored in the jig, Fig. 5. These were placed in the recess and secured by means of screw or the clamps, Fig. 11. The two holes *x x* were put through; the six nearest to the outside were limited holes, as shown in Fig. 2. All of these holes were simply spotted in the jig, after which they were removed and drilled. Then, after replacing them and inserting a pin in either of the holes *x x* the locating arc was milled with cutter *a*, Fig. 7. For drilling and boring the four inner holes the jig was used as a master plate, now using the locating arc and the pin *e*, Fig. 7, then drilling with a flat drill on a taper shank fitted to the tailstock spindle and boring in rotation. These holes were bored taper.

Profiling the Ring Blanks

Fig. 8 shows one of the ring blanks ready for profiling. The female form was located in the right-hand recess of the profiling plate and the ring blank in the other. A pilot similar to *d*, Fig. 7, but larger, was used with cutter *f*, which was concave at the end. Both of the profiler spindles were adjustable vertically. Two or three cuts were taken when roughing out. The sizing was done with a cutter 0.02 inch larger in diameter than *f*, Fig. 7, using a blank punching as a gage; also pilots with slight variation were available. As an experiment a roller was tried on these pilots, but was not considered preferable. For the angles *x v* the mills *b* and *c* were used, care being taken not to change the size of the ring. All of the forms were left soft as the wear was uniform and the pilots as a rule were the factors in determining the sizes.

Hardening and Grinding

The slot *B*, Fig. 1, in the rings varied from 0.05 to 0.07 inch, and metal 0.09 inch thick was inserted before hardening; 0.008 inch was left for grinding on the sides, that is, 0.004 inch on each, and 0.007 inch on the outside diameter, this being ground to 2.193 inches at the largest diameter after the ring was contracted to a little below normal size. This was done by means of the holes *x x*, Fig. 1, and a gage containing two pins, the distance apart being a trifle less than the center distance of the holes in the drill jig, Fig. 5. The rings when released expanded just enough to allow the operator to place the work readily and to fit the spring chucks. The sample forms were all of watch-plate material.

Wages and Increased Cost of Living

Much has been printed lately in the daily press about the increased cost of living. In this connection the opening paragraphs of the current monthly letter issued by the Commissioner's office to the members of the National Metal Trades Association is of more than passing interest. We quote:

"On the threshold of a new year which holds every promise of being one of extraordinary prosperity, it is well for us to look carefully into the condition of our shops, so far as they affect the comfort and happiness of our employees. Indistinctly, and, as it were, from afar, we hear mutterings which indicate the restlessness of labor. These sounds will grow more loud and menacing as the year advances. We have heard nothing of this sort for several years; but, with increasing prosperity, the familiar sounds and signs recur as an indication of labor's desire for a larger share in the profits of its toil.

"To increase wages as the demand for labor increases is good business. That it is doubly good business when an era of great prosperity is at hand cannot be denied. Let us see of what use it is to increase the wages of our employees:

"First—It will keep them in our shops, instead of driving them into other shops;

"Second—It will keep them contented and ready to work with hearty good will.

"Third—It will keep our product up to the standard and practice of the times, because it will enable us to retain efficient workmen.

"Speaking generally, it is fair to say that the wise policy for manufacturers is to pay their employees the best wages that they can afford to pay. Voicing the sentiment which pervades the councils of the National Metal Trades Association, we wish to impress upon our members the importance of remembering this. The more it is remembered and practised, the longer we will be immune from strikes and their consequences.

"The press of the country at this time is full of talk about the increased cost of living. The reasons assigned for this increase are many and varied; but the average writer seems not to be satisfied with the plain logic of the situation, but seems to be groping in the dark for some mysterious and ulterior cause.

"But be the reason what it may, the fact is undeniable that a dollar does not go nearly so far today as four or five years ago. It would seem, therefore, to be good business for all of our members to take to heart the foregoing advice on the wage question. Good wages; the proper education of employees—especially of apprentices; the adoption of practical and equitable profit-sharing systems—these are the important factors in the solution of the labor problem."

A Peculiar Break of an Elevator Worm Shaft

By D. Lustenberger

We have recently experienced a peculiar break on an electric elevator worm shaft. We would like to have this matter discussed in the American Machinist and learn the true cause of this break. The inclosed photos, see Figs. 1 and 2, show the worm and the ball thrust bearings just as they were installed; the shaft was 2 3/16 inches in diameter and was

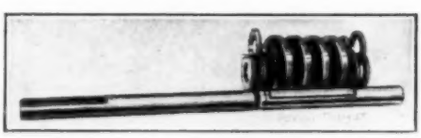


Fig. 1. Parts of Elevator Shaft and Worm in Relation Endwise

Fig. 2. Broken Shaft and Parts of the Thrust Bearing

cut in two within ½ inch before it broke.

The slot was just wide enough to admit one of the steel thrust washers. This happened on a high-grade elevator installed by the manufacturer, and had been run for many years and had sufficient oil at all time.

LETTERS · FROM · PRACTICAL · MEN

Concerning the Details of making things in machine shops, from the first sketch to the sale

Locating and Boring Holes in a Special Lever

The accompanying sketches illustrate a method of locating the three holes in a lever, Fig. 1, this being one of thirty levers to be bored to the figures given. As these parts enter into the construction of high-grade machinery, and as many men are employed simultaneously on the various parts, it becomes necessary to adopt accurate methods.

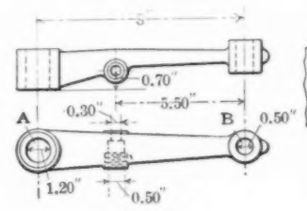


FIG. 1

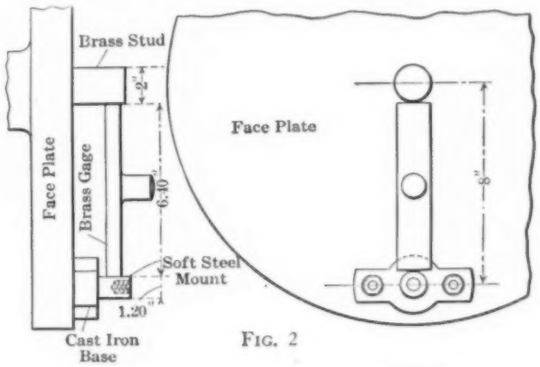


FIG. 2

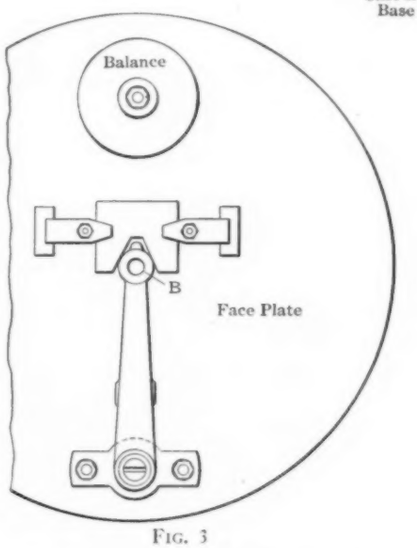


FIG. 3

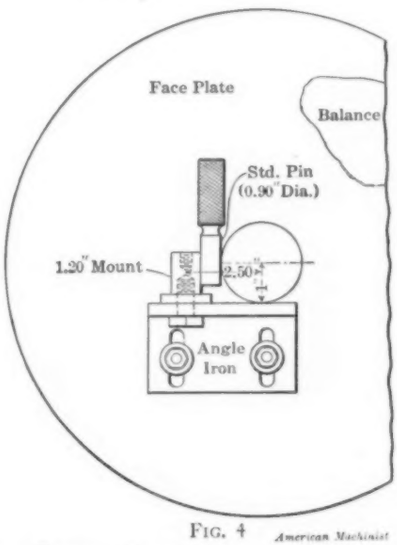


FIG. 4 American Machinist

LOCATING AND BORING HOLES IN A SPECIAL LEVER

The large hole *A*, Fig. 1, was first bored in all the levers, at the same time facing one side. These holes were then lapped to size. A suitable piece of brass was then chucked, turned to 1.20 inch diameter and used as an arbor for facing the other side, thus insuring both surfaces being parallel and at right angles to the hole. Fig. 2 shows clearly how the center distance was obtained between holes *A* and *B*. A soft-steel mount was driven in the cast-iron base, the bottom of this being planed. It was then swung up on the face plate when the mount was finished to 1.20 inch and the upper side of the base partly faced off. The brass stud soldered on a center blank was next turned to 2 inches diameter. An arbor held between centers could be substituted for this if desired. The gage, Fig. 2, was made of sheet brass soldered to a shank which was gripped in a chuck while the gage was turned to the required dimension. The cast-iron base with mount was then adjusted by means of the gage, then securely clamped.

Fig. 3 shows one of the levers in position for boring hole *B*. A block of hard wood was used for a support behind the lever while drilling. Fig. 4 shows the arrangement for the intermediate hole. The circle represents the end view of the brass stud, Fig. 2, with the upper surface of the angle iron in contact with it, the mount being adjusted and secured by means of the standard plug and screw respectively. Upon removing the stud the work was placed on its mount, and clamped to its base with a washer and a screw fitting the tapped hole shown. The work was supported as in the former case while being drilled, reamed, counterbored, and tapped.

This method is also applicable to other work, as for example, a worm and gear case in which the distance between centers is given in three-place decimals.

Elgin, Ill. G. HESS.

Hogging It

In a recent *Official Gazette* is another example of the man who is always taking advantage of necessary rules to advance his own interests. In prosecuting applications for patent one year is given in which to make sufficient answer to an office action. In case of a difficult application or sickness of an applicant or attorney a year's time is sometimes none too much. But a patent term does not begin until the issuance of the patent and some applicants think this rule should be worked to delay the beginning of the term of their patent.

In the case above mentioned the application was filed February 4, 1901, rejected February 25, 1901; amended February 12, 1902, rejected March 11, 1902; amended February 28, 1903, rejected April 7, 1903; amended April 1, 1904, rejected May 20, 1904; amended May 20, 1905, rejected October 12, 1905; amended October 4, 1906, rejected December 4, 1906; proposed amendment November 18, 1907, office letter holding case abandoned March 3, 1908. The last action by the applicant was held to be insufficient in certain respects and the application abandoned.

The office is naturally glad of an opportunity to catch such an applicant on a technicality. He insists on the office living up to the rule that he is entitled to one year for a reply and he shouldn't complain if the office insists that he shall strictly live up to the rules also. Such a person is, however, usually the first to think he is being abused when the tables are turned.

But even then this applicant had not got through with his dilly-dallying tactics for in reply to the office letter of March 3, 1908, holding the case abandoned he filed a request for reconsideration on March 1, 1909. Holding of abandonment was repeated April 13, 1909, and the petition to the commissioner was filed September 7, 1909.

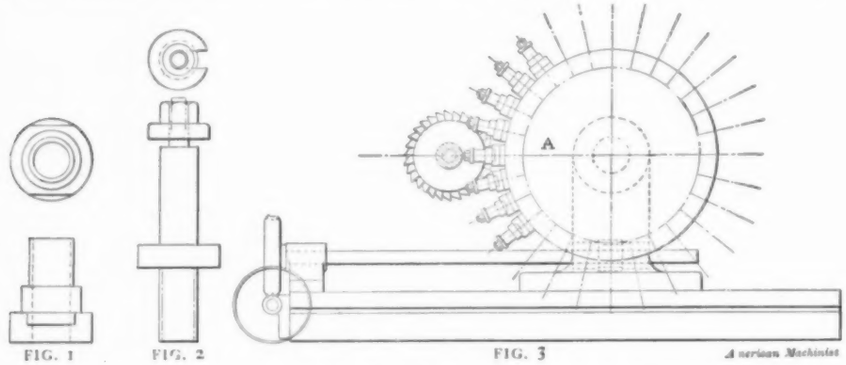
Lowell, Mass. P. V.

A Milling Fixture

Fig. 1 is a brass casting of which there were several thousands to make in the least possible time.

The milling of the small flats on the largest diameter was done on a vertical dividing plate having a central stud to carry the work. One side was milled, the dividing plate then turned 180 degrees and the opposite side milled in a similar manner, the table of the milling machine being fed by hand.

By working hard a man could "flat" 120 per hour in this manner. One of the several methods suggested to increase the output is shown in Fig. 3, and though it was not adopted, owing to prohibitive cost, it is interesting and may be useful for other work of a similar nature.



A MILLING FIXTURE

The fixture bolts onto the table of the milling machine. It consists of a bracket having a long bearing in which runs a shaft carrying a disk at one end and a worm gear at the other. The worm gear is driven by a worm which receives its motion from a pulley (driven either from the countershaft or the cutter spindle) through a worm and worm gear.

In the rim of the faceplate, which is about 14 inches diameter, are screwed 28 studs (shown in detail in Fig. 2) to carry the work. A pair of milling cutters are mounted on the cutter arbor, the space between them being adjusted, of course, to give the correct distance across the flats.

It will be seen that the studs have slip washers so that the work may be lifted on and off without necessitating the complete removal of the nut. Once started, the action of the machine is continuous, the face plate revolving at a constant speed, the operator simply removing the finished pieces and replacing them with unfinished ones from the position at the right of the machine.

The speed is determined by the rate at which the operator can feed the machine. We estimated that he would be pretty busy if he did 450 per hour—this allows him only eight seconds for fixing each piece so that he wouldn't have much time for bad habits.

This rate is equal to a linear feed of 12 inches a minute but considering the very light cut and the fact that the material is brass this is by no means abnormal. The curvature of the shoulders of the flat caused by the circular movement is so slight as to be hardly noticeable and even if it were more noticeable it would do no harm as the flats are only required for a wrench.

York, England. A. C.

A Pebble Mill Repair Job

Several months ago we installed a large pebble mill in our plant. In spite of everything we could think of in the way of lubrication the main bearings of the machine would run hot. The journals are 16 inches in diameter by 8 inches long, cored out to leave only about 1¼-inch walls. The boxes were plain babbitted ones with an oil cellar for lubrication. The journals were not exactly in line and had warped out of round after being machined.

I took the boxes off the foundation, broke out the babbitt and bored them out 1½ inches larger than the journals, leaving a square shoulder at each end. I then made enough rollers out of ¾-inch round, cold-rolled stock for the job, and rounded them well on the ends.

The boxes were then replaced and the rollers inserted, when we had a job that has never since given us a moment's trouble.

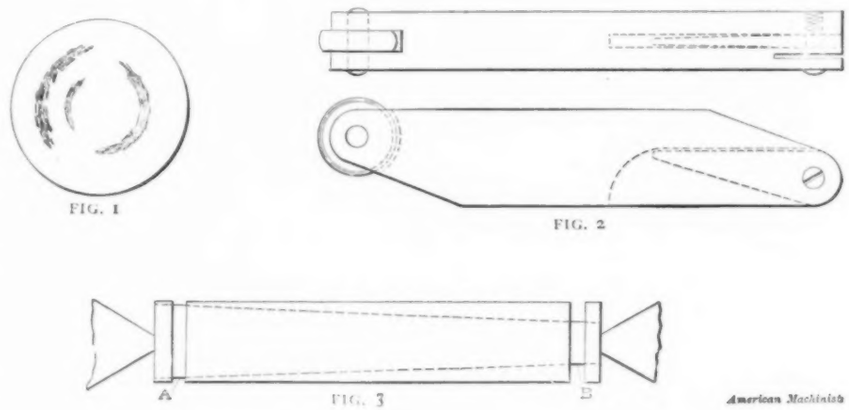
Tropico, California. E. M. DAVIDS.

Facing Washers, a Combination Roller Tool and a Caliper Point

Some time ago the AMERICAN MACHINIST published an article describing a method of holding washers in the lathe chuck while facing one side parallel to the other.

Recently I was employed in a job shop running a lathe. In cutting off disks it often happens that the cut-off tool mars one side of the work, which then has to be refaced. If the lathe is in fairly good condition the cut-off will not gouge until it has passed into the work at least ⅛ or ¼ inch. This leaves a narrow, smooth surface parallel to the other face. A washer marred in this manner will have an appearance somewhat as shown in Fig. 1.

In order to chuck this washer so that the marred face will run in a plane parallel to the other surface, grasp it lightly in a three-jaw chuck, start the lathe and present the roller which is mounted in a holder held in the tool post, to the narrow, smooth surface near the outer edge. The surface will be forced into a plane at right angles with the spindle. Stop the lathe, tighten the chuck, remove the roller from the tool post and face the washer.



A ROLLER TOOL

Fig. 2 shows a combination roller tool which I designed. At one end it has a roller, at the other a caliper point, which, when not in use, folds back into a milled recess. The tool is very similar in shape to an Armstrong tool holder. Another use of the roller tool is in truing up round work which is bolted to the faceplate. The lathe is started and the roller is presented to the periphery of the work, which is then forced into a concentric position. I often use the caliper point to

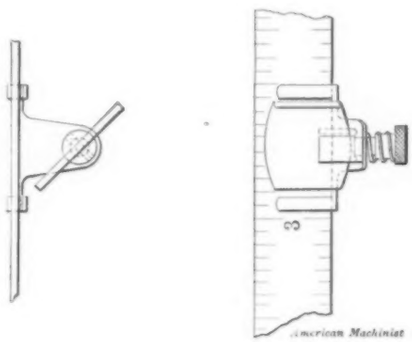
set the lathe for turning tapers. While this method is old, I had best describe it to illustrate the use of the tool.

Mount the piece on centers and at each end turn a small space *A* and *B*, Fig. 3, of the required diameters. Put the combination tool in the tool post and set the caliper point so that it just touches the work at *A*. Swing the point so that it clears the work, and move the carriage until the point is opposite *B*. Hold the caliper point in a horizontal position and move the tailstock at right angles until the small diameter touches the point. The taper is now roughly set. To be more accurate repeat the process, because any change at *B* will cause a slight change at *A*.

San Francisco, Cal. FRESHMAN.

Mirror Attachment for Scale

The sketch shows a handy attachment for a steel scale on a combination square. As every machinist knows, when setting the surface gage from a steel scale, placed upright on a surface plate, he has



MIRROR ATTACHMENT FOR SCALE

to have his eyes on a level with the surface-gage point and the scale to get the right setting, and for that reason he must bend his knees or assume some other uncomfortable position. The purpose of the attachment is to make this unnecessary. It consists of a small mirror and a frame for holding the mirror to the scale. The mirror must have an angle of exactly 45 degrees to the rule. The mirror is movable and can be turned through an angle of 90 degrees to its present position if it is desired to use it on the other edge of the scale. The mirror, as well as the frame, is made of hard brass and nickel plated, but, of course, the mirror must be very smooth and highly polished. A glass mirror can also be used, but is a little harder to fasten to the device.

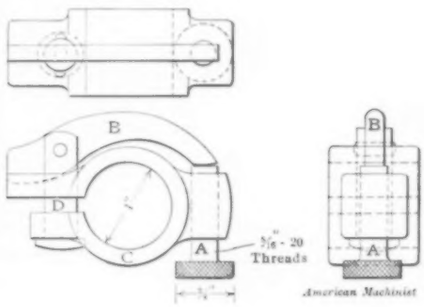
When using the attachment, the workman can stand straight and look in the mirror from the top, observing that the point of the surface gage is kept tight to the steel rule. For a machinist who has to do such work constantly the attachment is a great help.

If the mirror is made a little concave (the circle should not have less than 5 inch radius) it acts as a magnifier, thus answering two purposes.

Newark, N. J. L. L.

A Drill Press Spindle Stop

The line-cut shows a drill-press spindle stop which is much superior to the split collar having a fillister-head screw to hold it in position. The nurled screw *A*



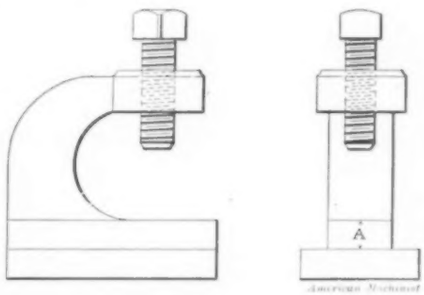
DRILL-PRESS STOP

actuates the lever *B* which clamps the split collar *C* by means of the pin *D*.

Rochester, N. Y. D. M. LEFEVER.

A Handy Machine Clamp

Looking through my scrap book the other night I came across Professor Sweet's "Dog with two tails." This reminded me of a tailless animal called a "bear" on this side of the water and which I have had in my mechanical menagerie. He was originally bred to perform on the milling-machine table but was found so



A MACHINE CLAMP

useful that others have been domesticated and trained for service on any machine having T-slots in the table. The cut is self explanatory; the only thing to remember is to get the dimension *A* less than the hight of the upper part of the T-slot.

Belfast, Ireland. TERRY.

Making Length Gages

The little attachment shown in the sketch was devised in connection with a job I once had of making some snap length gages from 6 to 24 inches in length of the type shown in Fig. 1; they were made of mild steel, carbonized, ground and lapped, and were required to be accurate as to length and a good "plug and ring gage fit" when finished, and as no measuring machine or outside micrometers were available, vernier calipers were to be used for measuring.

An inside micrometer of the range required being available, and having had experience of the finer degree of feel obtainable with inside gages with point-contact measuring surfaces in measuring internal plane surfaces, over that when measuring external planes with tools having plane contact surfaces, I conceived the idea of attaching end plates to the inside gage, thus temporarily converting it into an outside gage, then measuring both gages by transferring the size from the vernier with the inside

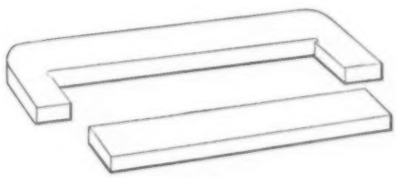


FIG. 1

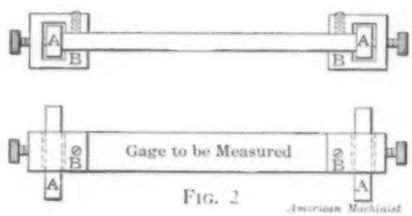


FIG. 2

MAKING LENGTH GAGES

micrometer, thus using the same kind of contact in sizing both gages, as is used in obtaining the size from the measuring tool.

Fig. 2 shows the little rig attached to an inside gage to permit of its being measured as before described. The end plates *A A* are hardened, ground and lapped dead flat on the business faces, and left sufficiently long and wide to overlap the ends of the gage as indicated in the sketch, this extra length and width giving plenty of surface to measure on to insure the finished faces coming out parallel in both planes; they are held firmly in contact with the gage by the nurled-head screws carried in the clamps *B B*, these clamps in turn being secured to the gage by the headless screws shown.

In use, the vernier was set to the size

desired by the aid of a strong glass; the one face of the gage having been finished (ground or lapped, as the case may be), an end plate was clamped to it and the other face worked down, frequently checking the length by attaching to it the remaining end plate, and testing in relation to the vernier by feeling in both with the inside micrometer. Making the outside gage will, of course, need no description as the method is the same with the exception that no attachment is required.

Length gages made by this method are quite satisfactory and the fit all that can be desired.

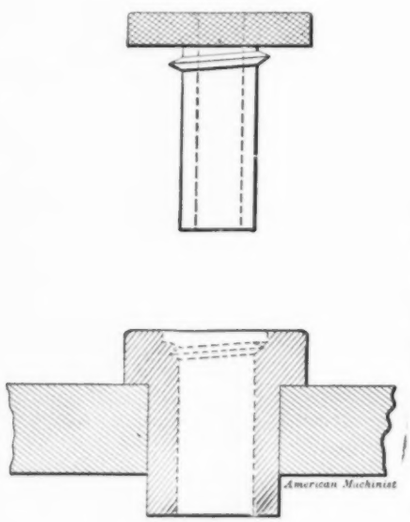
GEORGE E. GAY.

Manchester, England.

A Slip Bushing for Jigs

The line cut shows a very good form of slip bushing provided with a lock which prevents it from being forced from its seat by the chips.

The bushings are machined as usual



A SLIP BUSHING

with the exception of leaving metal on the slip bushing to cut one-half turn of a ten per inch thread up near the collar with a ⅛-inch recess behind it to allow the tool to clear.

The female is then counterbored ⅛ inch deep the top size of the thread and then one complete turn of a 10 per inch thread (or ½ turn if desired, but one turn will assure that the male thread is not going to the bottom) is cut.

When the slip bushing is slipped down until the threads mesh and given one half turn the bushing is locked and one-half turn releases it.

It gives no chance of working out as the drill is always turning it toward the shoulder.

Elmira, N. Y. TOOLMAKER.

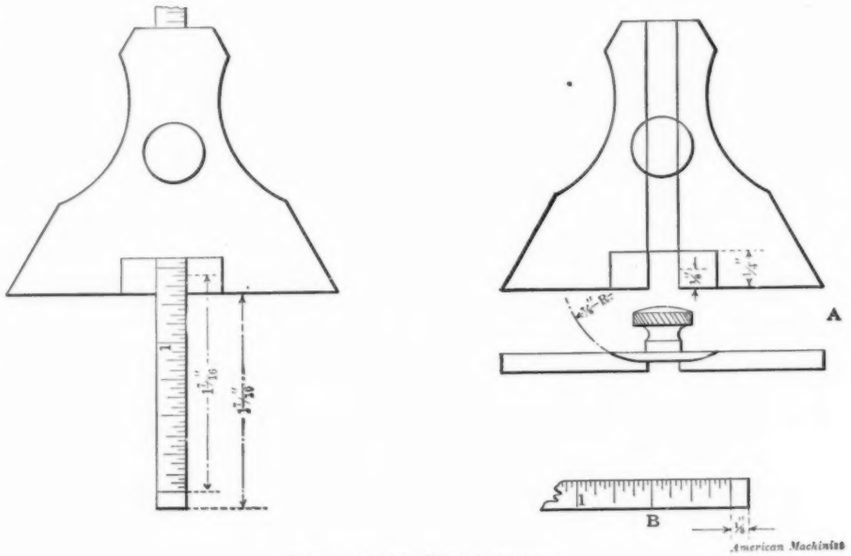
Depth Gage Improvement

Having noticed that nine men out of ten when using a depth gage, hold a scale up to the gage to find the actual measurement, I am showing an idea which will overcome this and give a quick and more accurate reading.

As shown at *B* in the sketch, the graduation on the scale starts ⅛ inch from the end. The head is milled away as shown at *A* and a line cut in the center of the milled portion ⅛ inch from the bottom surface. When using this gage, instead of reading from the lower edge, read from the line in the center of groove. I have been using this gage for the past few months and find it very satisfactory.

Several of my fellow workmen have had their gages changed also, and all agree that this arrangement is far superior to the old one.

Wilkes-Barre, Penn. R. C. SMITH.



DEPTH-GAGE IMPROVEMENT

What Causes Checking in Fine Finishing Steel Tools?

There are a great many peculiar things in this world of steel. There are some things we know, some things that we think we ought to know, and many things we do not know and are sure someone else does know. Your valuable paper generally brings the desired information from the latter, and therefore, when I get up against a problem that is going to be very expensive for me to determine, I appeal to your readers for the desired help. This has always been promptly and fully forthcoming and greatly appreciated.

My present difficulty is in the grinding of high-speed and fine-finishing steel. This latter is a water-hardening steel and throws a dark spark when ground, similar to high-speed steel. I invariably find that milling cutters 4 inches or more in diameter, in which the sides have to be ground, will come from the grinding department checked, and if the cutter is sounded for cracks it will not have the clear tone that it had before grinding. These cutters will sometimes stand until they are worn out and again they will break at the check.

We also find in grinding profile cutters that the shank will sometimes be checked in as many as 10 or 15 places, and if given a light tap with the hammer will break like glass. We can take these same cutters and strike them a hard blow before they are ground and they will not break; in fact, they will take a set rather than break, which convinces us that it is not done in the hardening. There are also other things that tend to prove that the trouble is not in the hardening, such as the checks running around the bar or tool in preference to running lengthwise as is the case when caused in the hardening.

Our trouble with the alloyed water-hardening or fine-finishing steel is similar to that met in high-speed steel, except that the fine-finishing steel will be soft immediately under the wheel even with water pouring on it, thus making it more difficult for us to understand the checkings. At times tools come from the grinding full of deep checks. In fact, I have seen them so badly checked that they would be sprung out of center as much as 0.03 inch. A piece with as many as 15 checks running around the tool, if given a light tap on the vise, would fall in as many pieces as there were checks. These tools would stand most any test that might be given them before grinding and show no sign of being checked.

We draw this steel to 400 degrees Fahrenheit to relieve all strain after the hardening. The tools that were found soft after grinding, were reduced in size a few thousandths and then would do excellent work. This helped to prove that the trouble was in the grinding, as the tools were hard before grinding and hard a few thousandths under the ground surface.

We think that we are using all the precautions that are possible in the selection of our wheels, as well as in caring for them, yet at times we are up against a serious and costly problem. At each time that the trouble is noted we are unable to locate the cause or prevent its recurrence. Can any reader of the paper suggest anything that might be the cause, or a remedy?

Davenport, Iowa. C. U. SCOTT.

A Compressed Air Boring Mill

There seems to be no better name than the above for the machine shown here-

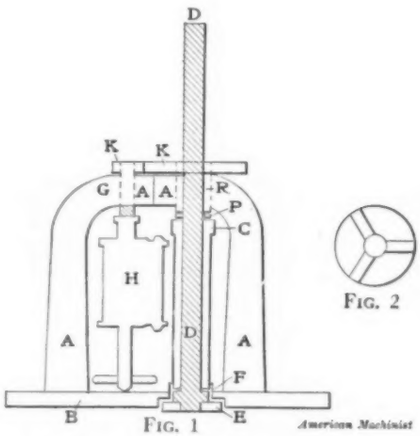


FIG. 1

FIG. 2

A COMPRESSED-AIR MILL

with, which was built when we had some large drums for a hoisting engine to bore out and bush. The drums were too large for the big lathe to swing, and as we had no boring mill, some other method had to be devised.

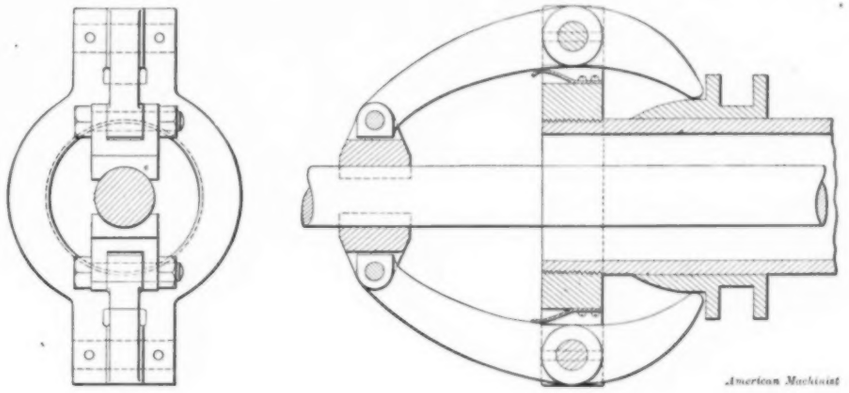
The machine consists of frame *A*, Fig. 1, which is bolted to the bedplate *B*. Power is furnished the boring head *E* through shaft *D*, which is geared through gears *K K* to a "Little Giant" air drill *H*, the ratio of the gears being 24 to 72. Any desired speed may be obtained by throttling the air drill.

The feed for the cutter is furnished by the sleeve *C*, which is threaded (not shown in drawing) and runs through the nut *F*. The cutter head, as shown in Fig. 2, carries three cutters which are set into slots and held by screws.

Graniteville, Vt. A. D. KNIGHT.

A Steady Chuck

The line cut shows a steady chuck for the rear end of the spindle of lathes of screw machines when turning long stock. It is light in weight, can be quickly operated and does not cost much to make.



ARRANGEMENT FOR STEADYING ROD

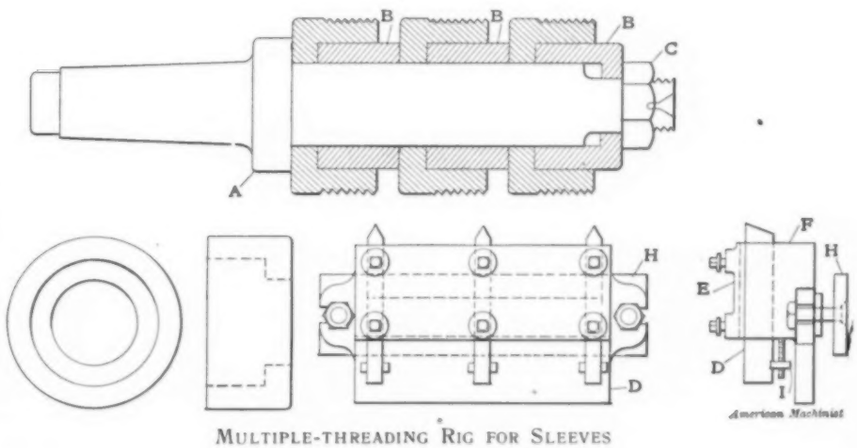
Extra jaws can be made for different sizes of stock or interchangeable half bushings can be used.

Camden, N. J. C. E. C.

Multiple Threading Rig for Sleeves

The line cut shows a machine-steel sleeve and a fixture for threading three of them at one operation.

A is an arbor fitted to the lathe spindle. The sleeves to be threaded are placed on this arbor and held in position by means of three bushings *B* and clamped together by nut *C*.



MULTIPLE-THREADING RIG FOR SLEEVES

The main body of the fixture *D* is made in two parts *E* and *F* riveted together. *D* is clamped to the slide rest by *H* and two bolts as shown.

The tools are ground to fit the slots in the fixture, each one being held with two set screws and adjusted by the nut *I*.

Detroit, Mich. G. H.

What Things, in the Shop, are Insignificant?

This story was told me by a man who had been mechanical head of a large shop in Massachusetts. I believe it, but no one else is obliged to do so.

In the shop referred to duplicate small machinery is made in large quantities. For years it has been the custom on certain jigs and operations to use toilet paper as packing. A certain jig might require two thicknesses of it under a certain part and a gang of mills might require one or two thicknesses placed here and there. These places were known to the men using the jigs and fixtures. For years one brand of paper had been ordered by the purchasing agent and "a toilet paper" had become in that shop just as fixed a unit of measurement as a "brick" to the bricklayer or a "ten thousandth" to the toolmaker. No one ever questioned that "two papers" were "two papers," and no one ever thought of checking the toilet paper with the toolroom reference gages. So stationary had this stationery standard become that I would not have been surprised if the shop gages had been tested up to see if they agreed with a roll of toilet paper.

With the years changes came; the old purchasing agent left and a new one was installed.

"A new broom sweeps clean," and this purchasing agent got after the "little leaks." Toilet paper was one of them. Six dollars a case was too much; paper could be bought for $4.50. So some $4.50 paper was bought and then the trouble began. Holes were drilled and reamed off square, pieces were milled too large or too small, and before the trouble was located enough work had been spoiled to pay for paper at the old rates for 50 years to come.

New York. J. WATT.

A Competitive Piecework System

I have read most of the articles published from time to time on premium and piecework systems, and in nearly every case the method of time fixing or price fixing has had some fault or doubtful point. That this is the weak and troublesome spot with most firms is evident by reading the advertisements that are constantly appearing for men experienced in ratefixing. The merits of piecework and premiums I do not intend to discuss here, but my object is to suggest a method whereby the superintendent or works manager of a large works can get the best results at the smallest cost.

I might say here that I introduced and have worked the following scheme for over three years with the results that the labor costs of a finished engine were reduced to less than one-third, and with less clerical labor.

Originally the engines were produced piecework and prices were fixed by ratefixers from costs already in possession of the cost department. The machines in the machine shop were more or less scattered about, and I got out a plan arranging the machines in groups, all one class of machine being grouped together. The groups were as follows: large lathes, small lathes, turret-bar lathes, large turret lathes such as Gisholts, Herbert's combination, etc., boring mills, milling machines, shaping machines and planers and boring machines. At the holidays I had them changed around to this plan, the layout of the various groups being made to suit the sequence of operations. Over each group of machines a chargehand or foreman was appointed according to the number of machines.

Under the old system the ratefixers got out the price and practically decided what machine should do the work and there was a certain amount of discontent among the men. Not only this but debts were continually coming in on piecework tickets, that meant either raising the price or discharging the man who contracted the debt. Under the new scheme, when a batch of engines were issued to the shops, I had a folio of drawings for foremen and chargehands' use printed and fastened together. Each chargehand went carefully through these and gave in an estimate for the different parts that he considered suited his machine, on a form supplied for the purpose. This form gave number of engines to be made, size, date of completion, and any other particulars necessary for carrying through the order. These forms were afterward returned with prices for their respective operation entered in as estimated by the chargehand. When the system was first introduced I found the boring mills estimating for work that the large turrets considered theirs and *vice versa*. Also millers and shapers were competing for some parts; heavy lathes with boring mills small lathes with capstans. After going through the estimates the result was that boring mills took work away from the hex turrets and the turrets took part work away from the boring mills.

The next estimates given for the next order resulted in prices dropping considerably, as each was anxious to secure the work. In addition, each chargehand commenced to give alternative prices for work if designs could be slightly modified in some cases, or in others if a special cutter or small jig or fixture could be made. These were considered when going through the estimates. When a chargehand gave in an estimate, he was naturally expected to keep within it.

The losses for the three months prior to introducing this scheme averaged 63 per cent. of the gains. For the last three months of the third year of operation the losses were 14 per cent. of the gains, and the last month 12 per cent. The cost of machine work for one engine in the first case was £280 ($1400) and for the same work at the latter date £90 ($450). The ratefixers were dispensed with and friction was almost unknown. Each machine got the work most adapted for it, and the question of which machine to buy when in the market due to rush of orders coming in needed but little consideration. It was necessary to increase the number of some of the machines, while others had to be tuned up to put them in the running at all. I might say that there were close on 500 machines in the machine shop.

In the fitting shops we decided to adopt the same system of chargehands giving estimates for work and dispensed with ratefixers, with much better results. With ratefixers it was one continual round of friction. The machines had taken a little too much off or not enough and they (the fitters) were not paid for making these little matters right. Under the new scheme, the chargehand took care of these matters and if serious cases did occur pointed them out and the question was soon settled.

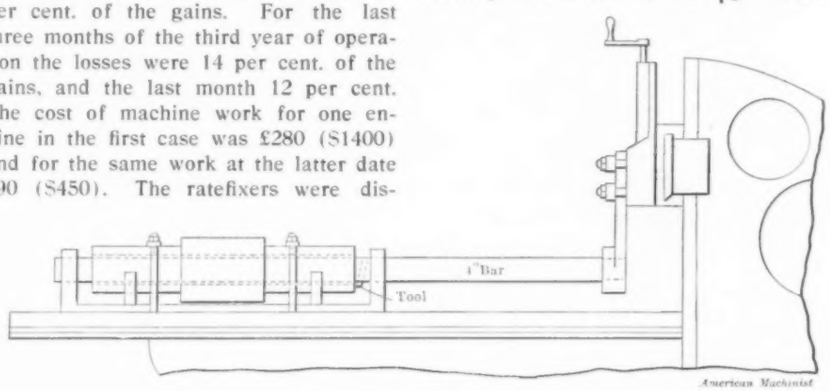
The erection also came under the scheme on their own asking, as we had kept these men on daywork to insure getting the best workmanship. An inspector was appointed (a man who was one of the best erectors we had) and the cost of erection (including the inspector's salary) was reduced 40 per cent. The inspector also acted as a tutor to the less experienced, and to the apprentices, and proved a great help to the foreman. The result was better workmen and workmanship.

This scheme will apply to shops working either the piecework or premium systems, the only difference being that the chargehands give their estimates in shillings and pence in the one case and in hours in the other. Job tickets will be made out just the same as before, only the price is fixed by the estimate instead of a separate ratefixer.

Sandiaire, England. OBSERVER.

Cutting a Keyway in a Long Bushing

In a shop where I am employed, we recently had a job of making a bushing for a heavy flywheel. The bushing was 4 feet 8 inches long, 10x12 inches in diameter, 5⅞ inches bore and to have a standard keyway its entire length. The question of cutting the keyway was somewhat of a problem with the equipment we had, but we did the job by making a cradle for the bushing, strapping the cradle and bushing to the planer bed and using a 4-inch bar in the tool post of the planer, as shown in the line-cut. The tool was fed down by striking it a light blow with a hammer at each stroke of the planer.



CUTTING A KEYWAY IN A LONG BUSHING

Columbus, Ga. FRANK HARGROVE.

? DISCUSSION of the PREVIOUS QUESTION ?

Letters from our Readers showing how many Men of many Minds look upon Various Subjects Opened up in previous Numbers

Strengthening a Press Beam

On page 1098, Volume 32, Part 2, C. L. S. asks about strengthening a press beam, and we are hereby trying to answer in

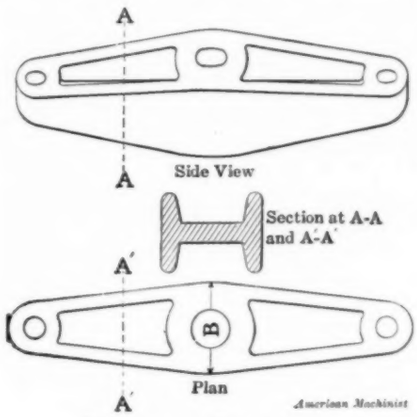


DIAGRAM OF PRESS BEAM

about the same way we answered a similar question for ourselves several years ago. The sketch will explain our process, which doubtless can be applied to this case. Of course, we do not know anything about the sizes of the beam or the strain it is subjected to, but on general principles if the sectional area at *A'A'* is made as great as that of the broken beam, this H-shape will be stronger; and the diameter *B* evidently should be increased. Of course, this all means a new beam, and no attempt to strengthen the old one as the question implies, but we think a new beam properly proportioned, will not only be best, but just as cheap, and far more mechanical and satisfactory.

Burlington, N. J. B. W. PENN.

Dies for Forming Tubes

At page 839, Volume 32, Part 2, A. B. Card inquires as to the best method of manufacturing a taper article of 0.02-gage brass. I am submitting a description of the way I should do the job. Of course, there are several ways of doing it, but I believe this method as practical as any. I hope that through the columns of the AMERICAN MACHINIST we who are interested in all classes of tool work may be able to find out the several methods of handling this problem and profit accordingly. I for one would welcome inquiries like this through your paper as a means of getting a better insight into different ways of doing work.

Fig. 1 is a sketch of a pair of dies which are used in a swaging press for reducing a tube to any desired taper. This set of tools I should use in the first press operation, after cutting off the tube, the length to be determined after these dies are made, as the piece will lengthen while being tapered. I think this method of getting the taper better than forcing in taper dies; on account of the metal used being rather thin, I am afraid that the walls would double in while tapering. The tube I should suggest using would be 1⅜ inches diameter, the size of the large end of the taper,

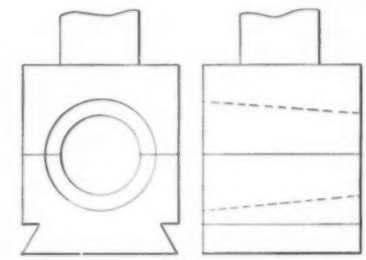


FIG. 1

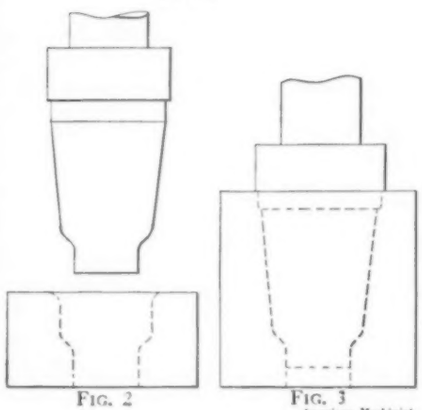


FIG. 2 FIG. 3

TOOLS FOR MAKING TAPER TUBES

which would mean that the tapering dies should be a trifle over that diameter so that the tube could be entered while the press is running. The stroke of the press should be from ⅜ to ½ inch, so that when the dies meet they will open enough to allow the tube to be inserted easily.

It is customary to use a piece of wood to fit the top of the tube which in this case should be ¼ inch long; the end should be turned down a little below the size of the inside of the tapered tube. It should be turned as it is being pressed in the work, which is done by holding in the right hand; a slight pressure is sufficient to taper the tube, which is done very quickly and right to gage.

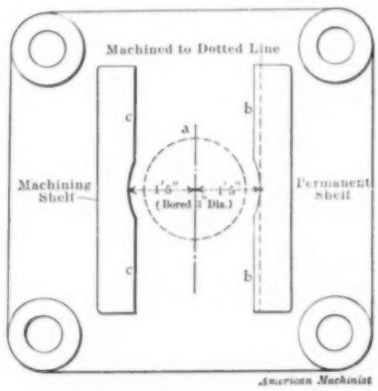
The tube should now be annealed and put through the next operation in the punch and die, Fig. 2. The punch is turned to fit the tube as it comes out of the swaging operation. The second operation could be done to the best advantage in a horizontal press, as in this case the tubes could be fed down a chute and, as a rule, an ejector is fitted in this style of press so it would be a simple set of tools to make. The small end of the tube should be left about 1/16 inch larger than the finished article.

Now the third and last operation is performed in a similar manner, but the punch and die are made as in Fig. 3, an exact copy of the finished article. In this operation the ¼-inch length at the top is expanded by the punch, and if the tools are made correctly it will form all the leads and radii exactly.

London, England. C. PETITJEAN.

Making Jigs and Fixtures

The article at page 913, Volume 32, Part 2, by W. L. Waterhouse will be of great assistance to others engaged in jig work. But, I would ask permission to suggest a better way of locating the precise position of the recess for the hub register *a*, than that shown by your contributor. He says in regard to his Fig. 1, which is a lathe fixture for boring a bracket, and is located on the faceplate by the hub *a*, that faces *b b'* were first machined, and to bore the recess for the hub a button was correctly located,



MAKING JIGS AND FIXTURES

the machined face placed on an angle plate, and the angle plate set to the correct position on the lathe faceplate by means of an indicator.

Without referring precisely to the particular jig shown in his article, I have

found in a general way the best way to locate a faceplate register for an angle plate, such as is shown herewith, is to provide the casting with a second shelf or projection as *c c* for machining purposes. Suppose, for instance, the face *b b* is to be located 1.5 inches from the center of the lathe register; the casting should be roughly lined off, the recess for hub *a* should be bored, and the adjacent face machined. The corner holes, four in number, should be tapped and the jig held to the faceplate by hexagon head screws. This being accomplished, the location of *b b* can be determined as correctly as an inside micrometer, or standard plug gage will enable it to be done; i.e., by boring the shelf *b b*, and with it the corresponding part *c c* to a 3-inch plug gage or a micrometer pin gage.

The argument in favor of this method is that we are working commercially accurately to diameters while the finished article is evidently in semi-diameters, and that if we err and bore the 3-inch registering cut 0.002 inch large, the finished product is only half this amount or 0.001 inch in error.

Having bored the register, the superfluous portion *c c* should be cut off and the face of *b b* machined down to the precise limits of the bored part.

The above method of working on diameters, when the finished article is in semi-diameters, will be found useful, and should be adopted by the jig and fixture maker on every possible occasion. If the details are large, it is not always necessary to cast an extra piece on the fixure; an old angle piece may be bolted up and skimmed through so as to give a boring size.

London, Eng. J. T. TOWLSON.

A Tool for Parting Pieces on the Planer

The letter from Joseph T. Toulson, from Silverton, England, on page 1051, Volume 32, Part 2, showing a parting tool, calls to mind a trick I had to resort to years ago in England.

I had occasion to cut off pieces of steel and iron in a very frail shaper. I could cut down fairly well at first but later the friction of the chip would be so great as to stall the machine.

By filing a groove in the face of the tool before hardening, it seemed to work as well on the last chip as the first, and I was out of my trouble.

I have tried repeatedly to get the makers of cut-off tool blades to mill a groove along the top and use that for the clamping gib to bite on as well.

But after all, there would be no use trying to put such a tool on the market, as about every machinist into whose hands they fell would be dead sure to grind off the top the first thing to make it flat and like the old one.

At the Artisan School, where we have a lot of gashing to do, the boys find that by grinding, with a thin emery wheel, a slight groove along the top of the tool they work much better, for the reason, of course, that the chip is narrowed up and comes out of the kerf easily.

Syracuse, N. Y. JOHN E. SWEET.

Machining an Automobile Cylinder

The article by Mr. McIntosh, at page 857, Volume 32, Part 2, appears to me to throw a curious side light on the production of this type of cylinder, and either the author has been through some painful experience, or current shop practice is altogether wrong. Lacking other information, it is assumed the cylinders dealt with are of the more usual mushroom-valve type, single, and having valves either opposed, or on one side.

Mr. McIntosh evidently wishes to impress upon us that, under present methods adopted for boring cylinders, a perfectly true bore is impossible unless the metal is symmetrical around the bore. This fact is known only too well by men handling the work to any great extent. Summing up the question of influence of design, so long as the mass of metal is not equally distributed about the center line of cylinder bore, *and throughout its entire length*, it is a commercial impossibility to produce an accurate bore before the cylinder leaves the machine shop.

From this it is evident that it will be better, and cheaper in the end, to admit some error, the extent of which may be limited, but as this latter is a point quite outside the scope of these remarks, it must be left to individual opinion.

Assuming for the moment it were possible to accurately machine a cylinder at its working temperature, do we understand that when it reached that temperature under actual working conditions, it would again be accurate? Further, if best results are to be obtained by machining them as nearly as possible under working conditions, would not someone have got out an approximate temperature at which a given cylinder should be machined in order to procure best working results? This might be arrived at fairly readily, and the fact that it is not the current practice, goes to show that either the practice or the ideal is all wrong.

Now if we have a similar cylinder under such conditions, that we know it is accurate (i.e., within prescribed limits) when it is cold, we know that any subsequent erroneous developments are due to actual working conditions, which leaves us in a position to modify any detail which may appear desirable. On the other hand, if we do not quite know what error is present in a cylinder (as each may vary), then how shall we assure the same relation between cylinder, piston and rings, especially where the limits otherwise tolerated are ridiculously close, as is not infrequently the case with automobile concerns?

As regards advantages to be obtained from different methods of finishing the cylinder bore, I agree it is usually a matter of opinion whether efficient working conditions are more easily and quickly obtained by grinding or reaming.

A general rule can hardly be given, since a ground surface may not necessarily be better under the particular circumstances than a reamed one; much depends on the efficiency of the tools used. A true bearing surface must undoubtedly be obtained between cylinder walls and piston rings before maximum efficiency is reached, but it cannot be said this occurs quicker in all cases, either by grinding or reaming, and it must, therefore, remain a question to be decided locally.

I think the question of grinding versus reaming arises to a large extent from a consideration of economical production, rather than from the fact that proper working conditions are more readily obtained. In the case of reaming, Mr. McIntosh is not consistent in his remarks about too much being expected of reamers, for if the second head *does* remove defects left by the first (and it should do so), then the reamer only has to deal with those of its preceding tool. If this is not so, then something is wrong with the design of the boring heads. Further, the number of boring heads should be kept as few as possible, in order to avoid multiplicity of errors.

If we admit the impossibility of obtaining a true bore, and resolve to accept reasonable inevitable error, then more real work and progress will be obtained. I am of opinion that the "close limit" basis is very frequently unnecessarily confined—one is almost tempted to say senselessly confined—and that as a result, much good and valuable work is wasted.

As an instance of this, I have seen cylinders in which the piston had a clearance of 0.015 inch, with a limit of 0.002 inch on cylinder bore—and another make where piston clearance was only 0.003 inch, and limit on bore 0.0005 inch. During an extensive observation, better results were consistently obtained under reliability trials with the former, thus showing beyond doubt that no practical advantage was obtained from increased expenditure in producing cylinders with exceptionally close limits.

Coventry, Eng. H. PEARMAN.

Follow up Letters, and Systems

I was much interested in the article by Entropy on the above subject, on page 714, Volume 32, Part 2, and wonder whether the "form," "standard" or "model" letter, as it is variously termed in different quarters, is of the benefit which its senders intend it to be as a business getter. My firm opinion is that a great deal depends on the nature of the trade it is written in the interests of.

For instance, where a firm is employed on a specialty, which is a standard product turned out on the mass-production principle, a standard or form letter can be made to answer inquiries in a satisfactory manner. Take the steam wagon [automobile truck] trade—these are used largely by brewers—a form letter addressed to those engaged in the malt and hop trade, stating that the spitfire steam wagon would create an unquenchable thirst among every teetotaler in the Kingdom, would not go astray if it got to a dairy farmer, as he would be able to adopt a wagon for his milk traffic.

Some firms I am acquainted with have their form letters numbered, and when the post is gone through in the morning, the letters are numbered with the number of form letter suitable for replying to that particular letter. These form letters are concocted by the principals who have spent a large amount of time on their composition, to give one the impression that they are "forceful" business pullers. They are sent out on "system" and scattered broadcast. Every one is entered on a card index, and if business does not result in 10 days, a still more "forceful" one is sent; and so on, until about half a dozen have been despatched. If still the intended victim does not respond his card is filed away in the dead box!!! for a few weeks, when another vigorous campaign is opened exactly as before.

I am connected with a firm who make a steam digger, one of the working parts of which quickly gets worn out and very often wants replacing. The owners often write saying we ought to replace it free, so the principal dictated a form letter as a standard answer to all and sundry when they went complaining. The firms who received these form-letter replies quickly arrived at the conclusion that this was a very common cause of failure, which was giving us some anxiety and trouble, because of the very fact of us sending a form letter. This form letter was certainly a mistake and did us a lot of injury.

The form letter is not the only nuisance which the post brings. There is the advise post card, which has printed on it that Mr. Bunkum will call upon you tomorrow, and that you must be sure and be in and have your orders ready for him to secure delivery next year. This gives you the cue to be out when Mr. Bunkum arrives.

Then there is the reply-paid post card which is the biggest nuisance of all. This has reached a fine art now; it comes along a double-barreled affair, with instructions how to tear it in two and return one-half to the sender, with a lot of code words and symbols on which to "tick off." The sender may eventually get a firm to carry out the printed instructions; he then consults his code key at home, which denotes the stage of the affairs in question.

Then there is the crank who sends an "addresslet," a printed name of his firm on a perforated, gummed paper; one-half tells you how to detach the opposite addresslet, stick it on your tongue and lick it; then it will adhere to the envelop you send the reply in, if you don't swallow it.

It is system run mad.

London, England. REFORM.

Cutting Taps to Allow for Shrinkage in Hardening

In the article under this heading by F. C. Mason at page 1141, Volume 32, Part 2, he shows an ordinary dog which will not give a constant speed at the angle shown which will have to be taken into consideration if the lead is coarse, especially if accuracy compels you to apply the above method; a pair of bevel gears will give the required results.

Chicago, Ill. C. G. KRANZ.

Leonardo's Universal Indexing Machine

I have read with great interest the articles on Leonardo da Vinci by E. P. Buffet in your recent issues. There is one piece of mechanism shown in Fig. 26, page 824, Volume 32, Part 2, and described on page 826, which I think I can throw some light on. Mr. Buffet thinks this is a kind of friction-driven drill press and the similarity at first glance is very striking, but he is rather doubtful and finishes by saying that it might be some kind of a grinder. I think the latter is much more likely to be correct. The following is my interpretation of the drawing and perhaps after reading it some of your readers will be able to form a definite opinion as to what the device was intended for.

If the drawing is examined carefully it will be noticed that the mechanism on the top of the box base is divided into two parts and that there is a gap between the part carrying the horizontal disk and the one carrying the division plate; also that the latter overhangs the end of the bed an amount equal to the gap. This part is evidently a carriage and the faint sketch off to the left shows how it is dovetailed to the bed of the machine. The purpose of the crank is now evident. It is simply a screw working through a nut fixed on the bed and is used for adjusting the carriage. The use of the semi-circular division plate on the front is quite evident. It will be noticed that there are eight divisions subdivided into halves. The vertical spindle does not revolve but is mounted on trunnions in the center of the horizontal axle so that it can swing through an arc of a circle in the same plane as the axle.

If one examines the detail view of the spindle it will be seen that the little friction pulley resolves itself into the eye of an eye bolt which carries two clamping plates and a wing nut. Also the bit appears to have a taper shank and to be much longer than in the principal drawing, so it apparently fits into the spindle like a lathe center. Now it is evident that the friction disk is merely another division plate to which the spindle can be clamped by the eye bolt in the curved slot shown. The end of the bolt and part of the nut are visible in the drawing. Division lines are provided; apparently 12, if allowance be made for half the thickness of the axle.

Having got so far, the problem is to decide whether the tool operates on the disk or something which it carries, or the disk operates on the tool. The former theory is rather supported by the fact that the cross bar over the disk is only held down by wing nuts making it easily removable for fixing work on the disk. If that is the case I cannot imagine the reason for the accurate adjustment of the spindle longitudinally of the axle. I am inclined to think that the disk is a lap or a grinding wheel and that the tool is placed in the spindle to grind. The end of the tool could be ground square by fixing the spindle vertical as shown and moving it across the disk, keeping the pointer in front vertical, or it could be set at various angles in either plane or a combination of both, or it could be fixed at a certain angle and rocked sideways to give the tool a rounded end, like a round-nosed turning tool. One can easily imagine the disk being pressed upward by a balance weight and driven by a bow-string connected to the treadle.

Considering that the machine was probably intended to be constructed mostly of wood, one would imagine that the carriage would cant and bind unless provided with corner stays, and if it had actually been constructed these would have been shown in the drawing.

Bradford, Eng. HAROLD SMITH.

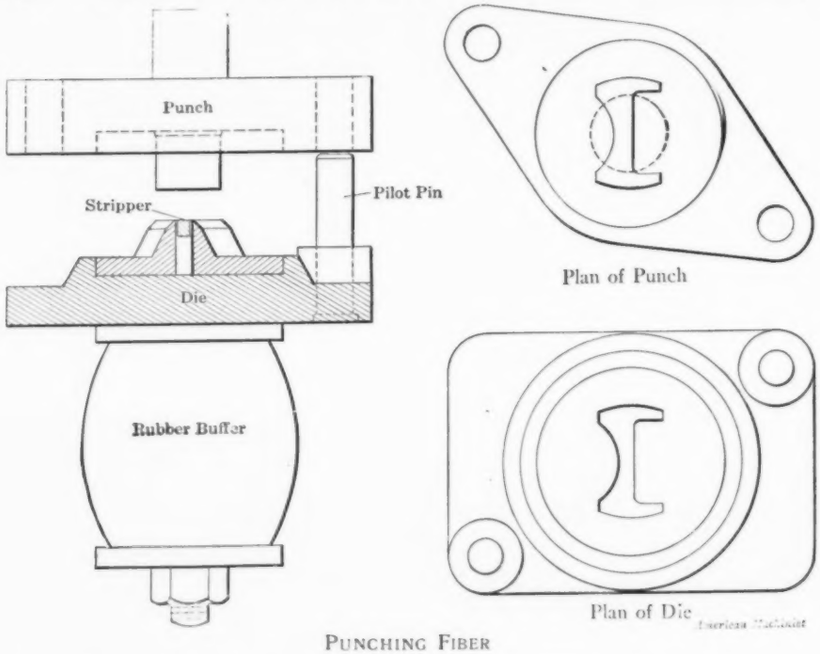
Mr. Smith has made an important contribution to our understanding of Leonardo's universal indexing machine. Drawing from his explanation a further

conclusion, we may now, with some confidence, pronounce the device to be a lapidary's wheel. Whatever its purpose, however, it embodies mechanical elements which are characteristic of refined modern machines for a variety of uses.

New York City. E. P. BUFFET.

Punching Fiber

Referring to the article on Punching of Fiber in the Punch Press, by Mark Dale, at page 915, Volume 32, Part 2, I suggest that he make the tool on the subpress system, as shown in the accompanying sketch. Certainly this will mean a little more expense in making the punch and die, but it will be well worth the outlay, for fiber is very hard and brittle, and must be cut by very sharp cutting edges, which Mr. Dale cannot keep on his punch and die principle as



PUNCHING FIBER

the second stroke is not the same as the first, and his punch does the cutting edges more harm in entering the die than the material itself.

I do not favor the copper pad which he uses as a punch; the edges of this punch will very quickly go around and dull and drag the material in the die instead of cutting it. The punch should be of steel, hardened and be a close fit all around the cutting edge of the die; also the die should be provided with a positive stripper, which keeps the material it is cutting under pressure all the time. I do not think the work can be produced under two operations, if the side face is to be smooth, but 0.010 inch all around for trimming is quite enough and the die will require very little grinding.

For making a cheap subpress die you require a punch holder and die plate of cast iron, a punch of cast steel, a die of steel-faced iron, two mild-steel pilot pins case-hardened, a stripping attachment and a guide.

Edinburgh, Scotland. E. KLAPS.

The Patent Situation

In a valuable article on page 877, Volume 32, Part 2, "Pseudo Inventor" makes some comments on my note (printed in a previous issue) asking assistance for inventors in prosecuting claims and testing ideas. My thought was that, as far as possible, none but valid patents should be issued. This, manufacturers, inventors, and the public at large, are entitled to.

The question of relative value of farmers and inventors is clearly shown by his own reference to the Japanese as a people, developing on agricultural lines, without the aid of invention. The great advance of this nation in the last 10 years has been entirely on mechanical lines. The wheat flour they have learned to eat instead of rice, and their ability to mill it so economically that they can sell the bran in San Francisco, shows what progress they may make when they become thoroughly familiar with inventions of the Western World.

As a "First aid to inventors" I think all patents in the subclasses should be passed on for validity by a board of examiners (such as the present board of examiners-in-chief) and the various subclasses printed in pamphlet form for public distribution at a nominal cost.

Perhaps I misled your readers by asking for an "abstract" as such a compliation would only be a summary or compendium, and would supply just what is asked for also by "E. C. S." on page 880, and others who have found fault with the present arrangement of subclasses. At the present time it is almost impossible to secure a complete subclass of any device, a report that one or more of the numbers called for is "out of print" is quite sure to come with the order. The only complete file being the one in the Patent Office, works a hardship on the inventor in Boston or San Francisco, who wants to make a preliminary search so that he may determine approximately how much of his idea has been anticipated by earlier inventors. And such a pamphlet would enable the manufacturer and investor to decide whether a patented device, when presented to him for introduction, contained sufficient novelty to warrant the necessary expenditure.

"E. C. S," above quoted, shows very logically when and where the assistance of an attorney is needed in the prosecution of a patent application, and brings out very plainly the fact that a "patent attorney is in the same catagory as the model maker * * * * much devolves therefore on the inventor himself." Now all this goes to show that if an inventor could secure a copy of the subclass of the patents to which his idea belongs, and would study it thoroughly, he could point out intelligently to his attorney, the new and novel features of his device.

From my own observation I think "Pseudo Inventor" is wrong in his idea that public shops in which inventors might work out their ideas, at a nominal cost for use of power and tools, would be monopolized by corporations. In the first place, permits would be given to individuals and not to corporations, and this of itself would insure to the individual the rights as a patentee to any features he might develop. Then I think I voice the sentiment of a majority of the corporations when I say that they would very much prefer to have well developed ideas brought before them than to be obliged to employ talent to develop them under what is in many cases considered a species of duress.

The argument has been raised that if inventors knew what had been invented on the line of a particular device they would not take out patents. I am far from agreeing with this argument, and furthermore, I believe that the loss, if any, in the number of inventions patented would be more than made up in the quality of those that were issued.

Some guarantee of the probable scope and validity of a patent as issued under such conditions would invite a class of inventors to enter the field that at present will not patent ideas, owing to the unsatisfactory and doubtful standing of a patent after it does issue.

It is the duty of every inventor to give personal attention enough to the subject to write to his representative in Congress urging revision (on business lines) of the work of the Patent Office.

O. C. KNIPE.

Washington, D. C.

Economical Machine Molding by Team Work

A specialization and sub-division of labor that will effect a saving in the cost of production, has been made possible in the foundry by the installation of the molding machine. This is well illustrated by the accompanying halftones and description. The Tabor Manufacturing Company's 13-inch jarring and hinged molding machine, that rolls over the molds and draws the pattern without the use of cranes or hoists, was the one used for this work. It was recently illustrated and described in these columns.

In the molding of these car wheels a team of 6 men was used on the one molding machine, which is shown ready to receive the flask in Fig. 1; with the flask ready to put into place at the left of the picture. These 6 men put up 50 complete molds per day of 8½ hours with an average loss for bad castings of 1 per cent. The team is divided up into one operator, who works the valves and levers that operate the machine, three helpers and two mold finishers; the latter being the only experienced men required.

A gang of night men is used to prepare the sand for the molds; shake out the castings, clean the flasks, place the bottom boards, flasks, sand, etc., in a convenient place for the machine men to use the next day. A traveling crane is used to bring the flasks to the machine, place in position the bottom boards, close the molds by lowering the cope onto the drag, carry the finished molds to the pouring floor, and after the molds are poured shake them out and stack them ready for the next day's work.

In building up the flask one helper places crane hooks on the flask trunnions, after which the operator and another helper guides it while being lowered onto the pattern plate, then the operator gives the machine one jar in order to settle the flask onto the pattern plate, and the second and first helpers clamp the two together. The third helper riddles the facing sand over the pattern and the operator distributes it, after which the operator and first and third helpers set the gaggers in the cope, as shown in Fig. 2, while the second helper is getting the bottom plate with the crane. The first

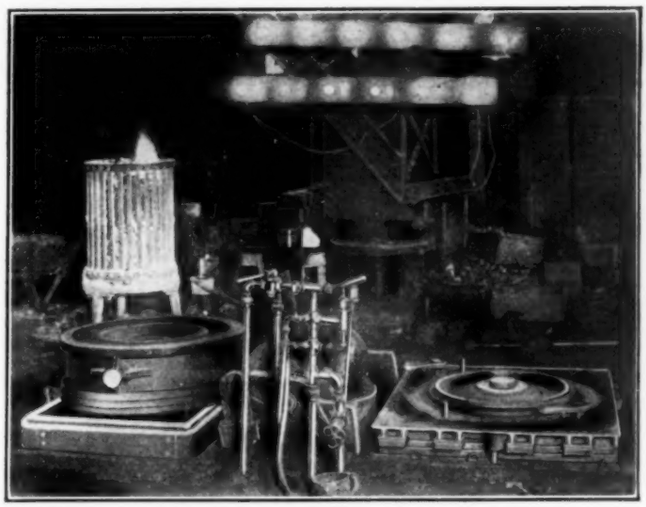


FIG. 1. MACHINE READY TO RECEIVE FINISHED FLASK, WHICH IS SHOWN AT LEFT

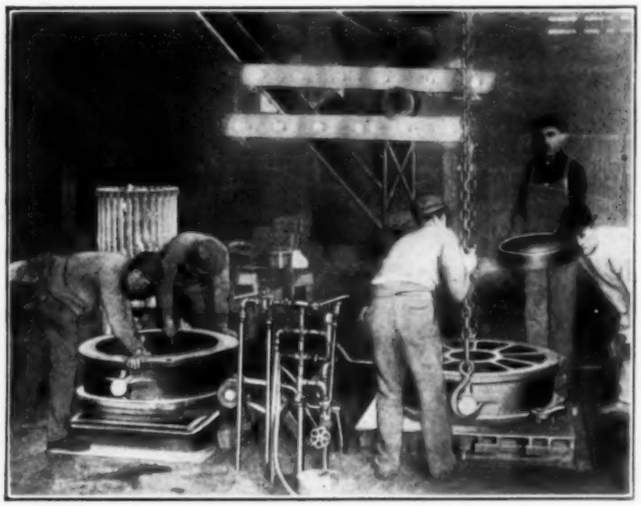


FIG. 2. LANDING FINISHED COPE, AS SHOWN TO LEFT, ONTO MACHINE

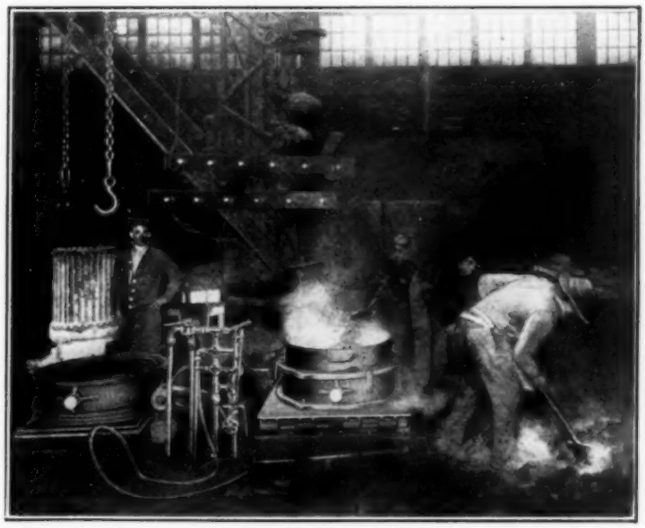


FIG. 3. FILLING SAND FRAME ON DRAG, WHILE COPE TO LEFT IS BEING MADE READY

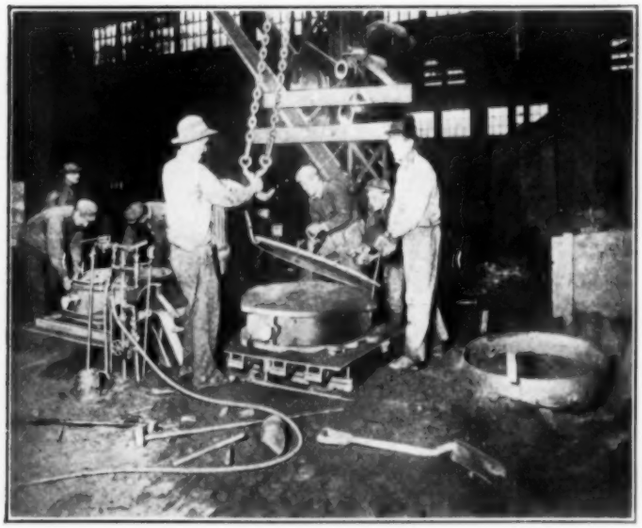


FIG. 4. LOCATING BOTTOM PLATE, WITH FINISHERS AT WORK ON COPE

and third helper then place the sand frame on the flask; four of the men shovel in the molding sand as shown in Fig. 3; the second helper levels this sand, while the operator gives the cope 21 blows and the drag 7 blows, according to which is being rammed by the jarring machine; the second and third helper removes the sand frame and strikes off the mold as the crane brings up the bottom plate. In the meantime the first helper has picked up two eye bars, one of which he hands to the third helper and they insert them into holes to guide the bottom plate into place while the operator is releasing it from the crane; after this he gives the machine a jar to settle it into place. The bottom plate is then bolted and wedged and the operator rolls over the drag flask as shown in Fig. 5 and at the same time blows any loose sand off with the blow valve. The pattern is then drawn and the finishers begin work. While the drag mold is being turned over the cope mold is being lifted by its trunnions so that it can be turned over and dropped into place on top of the drag mold.

In the meantime the finishers have been at work on the cope and as soon as the drag is released from the machine both finishers begin work on this, while the three helpers and the operators are ramming up another cope and drag flask. By the time the finishers have set the core and chaplet, closed the mold and put the runner boxes in place, another drag and cope mold is ready for them. From four to five minutes is required to finish a mold and remove it from the machine by this six-man team. Often a machine is rolling over one flask while the other flask is being removed from the equalizing cradle, as shown in Fig. 5. These pictures were all taken by flashlight while the team was going through their regular routine work and at no time did they cease work.

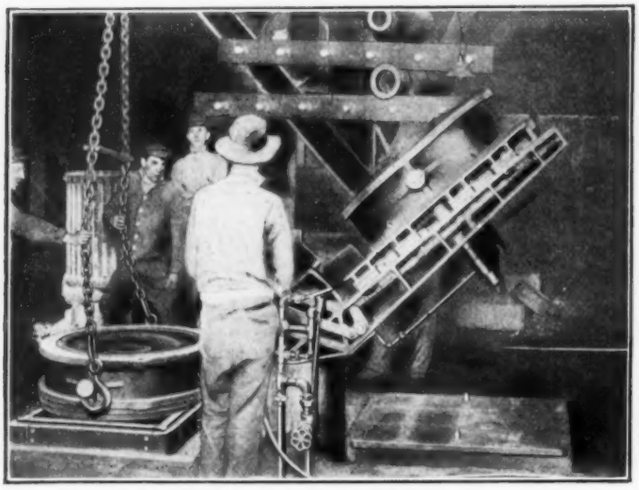


FIG. 5. ROLLING OVER DRAG AND RAISING COPE TO TURN OVER INTO PLACE

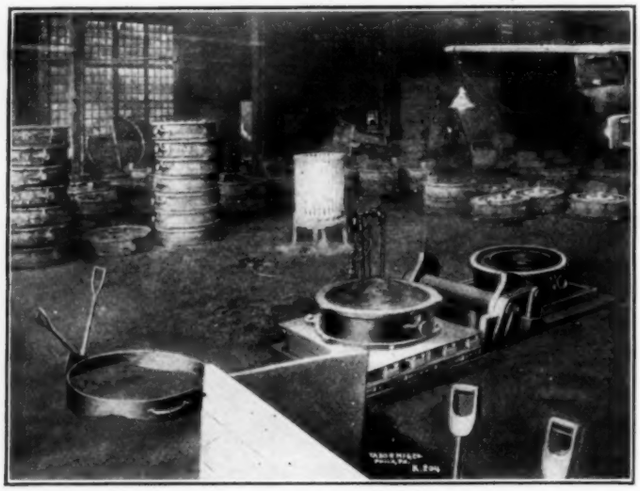


FIG. 6. GENERAL VIEW OF MOLDING FLOOR

Crane service assumed to be equal in both instances

Average weight of finished castings	700 lb.
Average weight of drag (flask, sand and bottom board)	1,600 lb.
Average weight of cope (flask and sand)	1,600 lb.
Maximum consumption of air per half mold = 160 cubic feet of free air or Maximum consumption of air per complete mold = 320 cu.ft. of free air or	32 cubic feet per minute

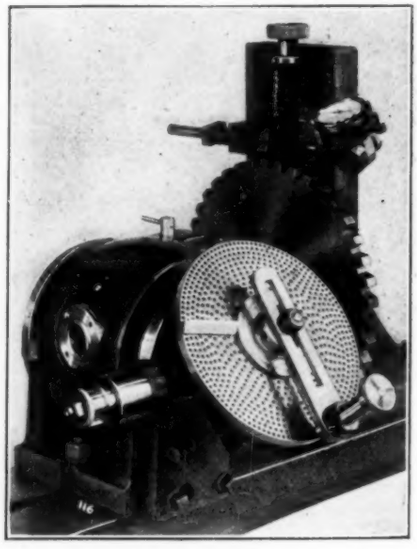
By Hand.		By Machine.	
10 molders at $4.00 each per day	$40.00	2 molders at $4.50 each per day	$9.00
10 helpers at $1.60 each per day	16.00	4 helpers at $1.60 each per day	6.40
	$56.00		$15.40
20 men put up 48 complete molds (48 copes and 48 drags) per day of 8½ hours		6 men put up 50 complete molds (50 copes and 50 drags) per day of 8½ hours	
Average loss in bad castings	14%	Average loss in bad castings	1%
Actual number first-class castings per day	41.28	Actual number first-class castings per day	49.5
Molding cost per good casting	$56.00 / 41.28 = $1.355	Molding cost per good casting	$15.40 / 49.5 = $0.311
Less cost by machine	0.441	Cost of air per casting	$0.042
Saving	$0.914	Cost of maintenance, interest charges and depreciation (20% per annum of total cost of machine) per casting	0.088
		Total cost per good casting	$0.441
Saving per casting			$0.91
Saving for 50 castings (one day's output)			45.70

By the old hand method it required ten molders and ten helpers to make 48 complete molds in 8½ hours, while with the machine 2 molders and 4 helpers can put up 50 molds. The time, wages, weights, cost of materials, castings, etc., are shown in detail by the accompanying table.

Testing a Dividing Head

The illustration shows the method employed in testing the accuracy of the worm wheel in the dividing head by the Kempsmith Manufacturing Company, Milwaukee, Wis.

A master plate having 40 divisions or teeth, which are as perfect as is possible, is mounted on the spindle, as shown. The maximum relative error allowed is 0.0005 inch and the maximum cumulative error at any point is 0.002 inch on the master plate, although the average is less than one-half of this. The master plate being 11 inches in diameter and the worm wheel 5¼ inches, multiplies the error which is indicated by the dial recording gage shown, and makes it possible to secure a very accurate dividing head.



TESTING DIVIDING HEAD

February 3, 1910.

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American Machinist

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Profit Sharing Not Necessarily an Expense

In connection with profit-sharing plans and similar benefit systems in industrial enterprises a frequently stated and well founded criticism is that such plans are too expensive for the industry to bear, and in particular are too great a burden for an individual plant competing with others in a given industry that are free from such a self-imposed expense. The other side is that the increased interest in their work on the part of employees, the opportunity to stop leaks and wastes and the stimulating of initiative may so increase the firm's business and earnings that the profit-sharing expense—the increased compensation of the employees—may be wiped out and additional profits left for the stockholders. A condition of real coöperation!

In support of this possible outcome of the establishing of profit-sharing plans and the like, we quote from a paper prepared by Geo. W. Perkins for the National Civic Federation, dealing with the profit-sharing, benefit and pension plans of The International Harvester Company:

"The company has been criticized by managers of other companies for making the plan above outlined too liberal and attractive. It has been said that the plans will be too expensive to the Harvester company and that their cost will be very large. There is no doubt of the truth of this criticism insofar as the cost goes. No concern has ever put out plans that involved the application of so large a percentage of its profits to such plans. But the Harvester company did not do this out of pure philanthropy. It had no intention of passing around a hat full of money, that employees might help themselves. It went into these enterprises in a purely business spirit, believing that the plans would so knit its vast organization together, would so stimulate individual initiative would so strengthen and develop the *esprit de corps* of the organization as to make it possible for the company to increase its business and its earnings—and with the spirit of being willing to share this increased success with its organization. So far the company has every reason to congratulate itself on the result. In all parts of the company's business, at home and abroad, in the office force, in the factories, in the sales department—everywhere, the average interest of the individual in the business is greater than formerly. The saving of the waste here, there and everywhere, is noticeable. The employees throughout the organization are vying with one another more and more to improve their respective branches of the business. This means profits for the stockholders, means extra compensation in various ways for the employees—in short, means coöperation that is real, that is beneficial to one and all."

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST.

Our circulation for January, 1910, *was (American weekly, American monthly, English weekly and German weekly)* 116,750.

February 3..... 39,250

This paper reaches 39,250 *separate readers each month and* 23,250 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Future of Anthracite Coal in the Shop

A correspondent in the *Engineering and Mining Journal* discusses the passing of anthracite coal and gives estimates from various sources as to how long the available supply will last. Some are apprehensive that anthracite will begin appreciably to diminish the next 15 years or sooner, as a dominant factor in the coal trade. One authority declares that the profitable exploitation of anthracite coal cannot be carried on over a period longer than 20 to 25 years. Coal companies emphatically assert that at the present rate of production anthracite will be exhausted for all practical purposes in 14 or 15 years, in the most productive strata, and within 10 years in the least productive.

In regard to the increase of yearly production, the tonnage for 1897 was, in round numbers, 52,000,000, and in 1908, 70,000,000 tons.

If we accept these estimates we must believe that the exhaustion of Pennsylvania anthracite is inevitable in from one to two decades, yet it is hardly necessary for us to be apprehensive from the viewpoint of mechanical industries.

In machine shops anthracite is burned to produce power in some cities, notably Philadelphia and New York, because smoke ordinances prohibit the burning of bituminous coal. In other localities bituminous is used for power purposes and anthracite for hardening, tempering and annealing furnaces and for heating forges.

With the possibility of a diminishing supply of anthracite fuel for these specific conditions and the probability of an increase of price as the supply is lessened in proportion to the demand, the question of using other fuels is well worthy of consideration. Shop equipment should be selected with due regard to possible changes. It is not neces-

sary to burn anthracite to have smokeless chimneys. We have frequently pointed out in these columns that smokeless combustion of steam coals is possible and practicable with proper conditions of boiler and furnace construction and proper care in firing.

In the hardening and forge rooms, furnaces and forges are already developed and in extensive successful use fired with fuel oil and gas.

Thus when it becomes necessary to buy new furnace or forge equipment, the shop foreman or superintendent may consider as an argument against hard-coal-fired appliances the restricting future production of anthracite coal.

Shop Appearances

The appearance of the shop is a subject that has been referred to again and again and quantities of advice and numbers of admonitions have been given to clean up under benches and around the machines, get rid of accumulations of junk and wash the windows at frequent intervals, etc.

All this is good in its way, but aside from all this is it not time to set up a new ideal in regard to the appearance of the busy shop?

The owner of a certain machine shop was called away on business for three or four days, and during his absence his shop foreman "cleaned house." He cleaned house thoroughly. He disposed of the accumulated junk and scrap, sent to the storage yard parts which were in the way and would be for weeks to come, straightened out the orders for material that were alive, and in general made the entire shop presentable. When the proprietor returned he expressed satisfaction with the change and said that then was the time to take a set of shop photographs. A day or two passed and the photographer appeared. The proprietor conducted him into the shop, picked out the locations from which he wished the pictures taken, then glanced at the orderly appearance of the machines and work, and suddenly stopped the photographer and ordered a quantity of castings, forgings and junk brought in from the yard and scattered around the machines in order to make the shop "look like business."

Is it possible that so many shop pictures have been published showing crowded machines and disorderly piles of work around them that any other kind of a shop picture does not "look like business?" If such is the case it is time to change our ideas of what a busy machine shop should look like. Is there any inherent reason why a lack of crowding and a general appearance of orderliness are incompatible with an uptodate busy, hustling shop?

Making Things Clear

Every foreman, and others who come in contact with men in any walk of life, can recall instances where intelligent men and boys have displayed gross ignorance regarding some comparatively simple subject. Taking a micrometer as an example, you will find many good mechanics who use them to some extent and yet who are not positive as to their readings.

This is not through any lack of intelligence but solely due to the fact that the foundation principles have never been made clear. The chances are someone has explained how to use it in a few cases and has taken it for granted that from that a mechanic would understand all about it.

That is one great weakness of nearly all teachers and writers. They take too much for granted and assume that the student or reader knows more than he does. This makes him hesitate to show that he knows less than he was supposed to, and he slides along, hoping to pick up the information some of these days when he will not have to display his ignorance.

All who have any kind of instructions to give should bear in mind that the failure to explain some little point may leave the whole statement in a hazy condition, and endeavor to be very clear, even at the expense of appearing to explain too much. It may soothe the listener's feelings to say "of course you know" but go on and explain just the same.

While this seems like a small matter, it will save many embarrassing mistakes, and mistakes are usually more or less expensive.

Examination for Draftsmen

The United States Civil Service Commission announces an examination on March 9-10, 1910, to secure eligibles from which to make certification to fill two vacancies in the position of topographic draftsman (male) in the Coast and Geodetic Survey, one at $1000 and the other at $900 per annum, and vacancies requiring similar qualifications as they may occur in any branch of the service. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application form 1312.

The examination, and points for each subject, are as follows: 1. Drawing (a specimen of topographic drawing will be given for reproduction in india ink), 35. 2. Lettering (tests of short words in different styles of lettering, and numbers are given), 35. 3. Mathematics (comprising arithmetic, algebra to and including problems involving quadratics, plane and solid geometry, plane trigonometry, logarithms, mensuration, and projections), 30.

PERSONALS

Items For This Column Are Solicited

Frank Salomon, engineer of the machinery house of Alfred H. Schütte, of Cologne, Germany, is at present in this country in the interests of his firm.

J. R. Shays, until recently connected with the drive-chain department of the Link-Belt Company, is now in the employ of the Pyott Company, Chicago, Ill.

A. E. Mills, who has been connected with the chuck trade for a number of years, has associated himself with E. Horton & Son Company, Windsor Locks, Conn.

S. B. Redfield, associate editor of the AMERICAN MACHINIST, delivered a lecture on "Air Compression" before the Providence Association of Mechanical Engineers at its meeting on January 25.

James Dangerfield, formerly in the Pratt & Whitney designing office, has accepted a position with the Davis Sewing Machine Company, Dayton, Ohio, as designer on the Lester automatic screw machine being built by that company.

W. R. Lathrop, who has been connected with the Niles-Bement-Pond Company's New York and Birmingham offices for several years, has severed his connection with that company, and has associated with himself M. E. Dewstoe, of Birmingham, Ala., forming the Dewstoe-Lathrop Machinery Company.

R. T. Hodgkins, who for several years has been in the chain-block and hoist department of the Yale & Towne Manufacturing Company, has been made manager of that department, succeeding F. A. Hall, who has resigned in order to accept election as vice-president and treasurer of the Cameron Engineering Company, Brooklyn, N. Y.

Henry Otto, foreman of the tool room of the Lehigh Valley shops at Sayre, Penn., has accepted a similar position in the tool room of the Sante Fé shops at Topeka, Kan. Upon the occasion of his departure from Sayre he was presented with presents, as marks of esteem, from the men employed in his department, as well as the superintendent and associates in management.

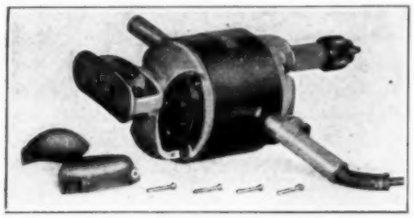
Otto Ruemelin, for several years assistant superintendent of Pawling & Harnischfeger, Milwaukee, Wis., has assumed the duties of superintendent, succeeding H. E. Frentzel, recently resigned. Mr. Frentzel, who has been superintendent for a number of years, was presented with a silver service by his associates as a mark of appreciation upon the occasion of his resignation.

NEW TOOLS and MACHINE SHOP APPLIANCES

Showing New Ideas in Machine Shop Equipment that make it possible to do better work at a reduced cost

Alternating Portable Drill

It often happens that the only current available in machine shops is alternating instead of direct, and to meet these conditions the General Electric Company has brought out the portable drill shown in the illustration to be used on either 110- or 220-volts, 60 cycle.



ALTERNATING PORTABLE DRILL

It weighs but 21 pounds and possesses all the operating features of the direct-current machine. There is an indicating control switch conveniently located near the right handle so that it can be stopped and started without releasing the grasp. The handhole plates are shown removed, giving easy access to the commutator and brushes. These machines are equipped with Jacobs chucks as shown.

A New Dividing Head

The universal dividing head is one of the most important details of the milling machine, and every designer endeavors

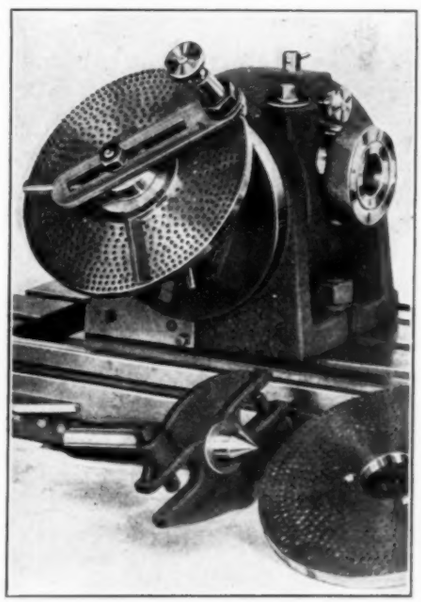


FIG. 1. KEMPSMITH DIVIDING HEAD

Any new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department—the machine-shop news.

A full and detailed description—the device featured—when of special interest and it can appear here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

to use as large a worm wheel as is possible. In the design shown the worm wheel is in the center of the head block and placing the worm at the angle shown allows a large wheel to be used, 5¼ inches in diameter on the 10½-inch swing and 6½ inches on the 13¼-inch head. This also throws the index plate into a convenient position for the operator. The worm throws out for direct indexing.

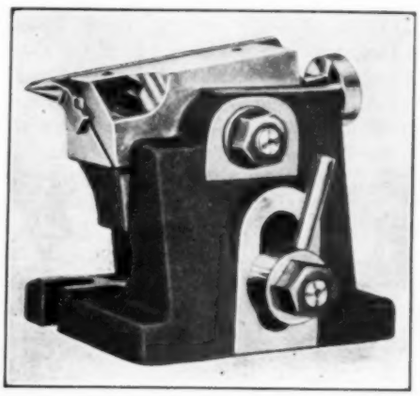


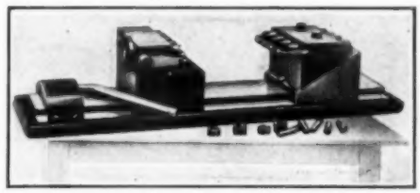
FIG. 2. THE TAILSTOCK

The tailstock is of the side-center type, the center being set in at an angle which brings it within ⅛ inch of the inner side and within the same distance from the top. The center is firmly fixed in the tailstock, as shown, can be elevated by rack and pinion for milling tapers, or can be tilted and clamped in alinement with the work as shown.

The head is furnished with 12 change gears for spiral milling, and charts are supplied which give the leads to cover all classes of work. For short leads the gear train is led direct from lead screw to spindle instead of going through the worm. Two index plates are regularly furnished covering practically all work that is ever handled, but special plates can be furnished if desired. These are made by the Kempsmith Manufacturing Company, Milwaukee, Wis.

Four-spindle Index Centers

The halftone shows a four-spindle fluting device, applicable to any milling-machine table, which is being put on the



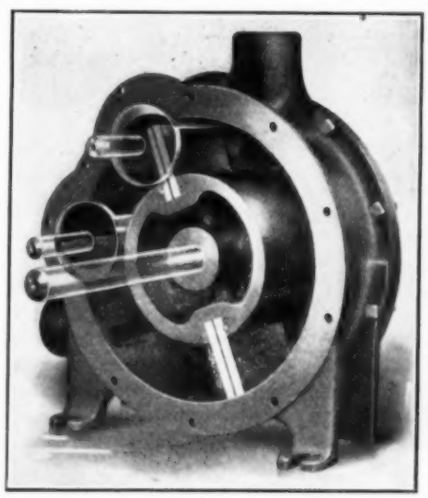
FOUR-SPINDLE INDEX CENTERS

market by Bickford & Washburn, Inc., Greenfield, Mass.

The tailstock which can be elevated for taper work is secured to the dovetailed base by set screws while the headstock is movable thereon by means of the lever shown. A complete turn of the indexing lever indexes the four spindles simultaneously to the correct division. From 3 to 8 flutes may be spaced, the indexing being determined by the numbers of teeth in the indexing bevel gear and pinion. The tail spindles are self adjusting by means of heavy coiled springs. Two sets of driving dogs, for round and square work, are provided.

A Pressure Blower

The halftone shows a pressure blower which has been brought out by the Funk



A PRESSURE BLOWER

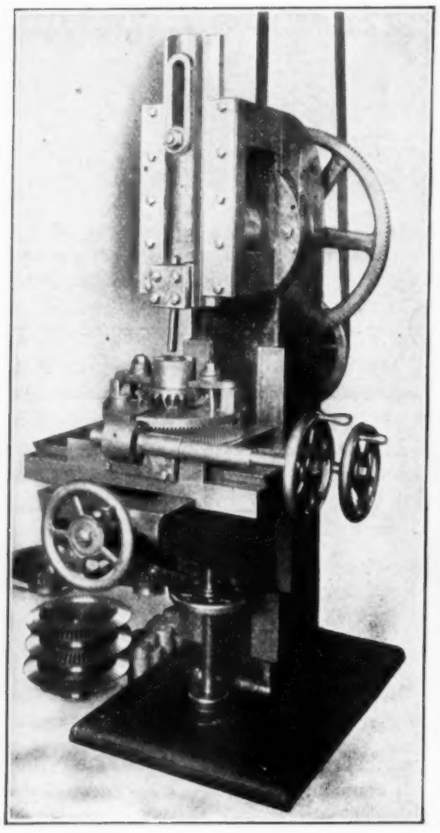


FIG. 1. A CONVENIENT SLOTTER

FIG. 2. WORKING WITH INCLOSED HEAD

Machine Company, 23 City Hall Place, New York. The central cylindrical member is twice the diameter of the two corliss type valves to the left, and is geared on the outside of the case to them by gears having a ratio of 2 to 1. The intake is shown to the left near the bottom and the outlet is at the top. The two blades are secured in the central member and are a snug running fit in the shell. Owing to the timing of the gearing the corliss valves are in such position that the blades are free to pass them when they reach them. At all other times they are closed in the recess in the shell and on the perimeter of the central cylindrical member. The direction of rotation of the blades is counter-clockwise.

A Convenient Slotter

The illustration shows two operations being performed by a new slotter which is being built by the Pottstown Machine Company, Pottstown, Penn., and which has several peculiar features. The slotting head can be inclined to any angle and in addition to this the table can be tilted 45 degrees so that it becomes possible to cut the teeth in a miter gear should it be found necessary. The table screws are set to one side of the center so that a hole can go through the center of the table to receive such work as spindles requiring square or other shaped holes, or to have keyways cut in them.

Fig. 2 shows a special chuck being slotted, which is made in one piece with the spindle, two sides being square and the other two taper. No laying out is required owing to an index on the circular table. The machine has quite a wide range of usefulness, the distance from the column to the center of tool being 12 inches, the circular table 14 inches in diameter and the tilting table having a vertical adjustment of 16 inches.

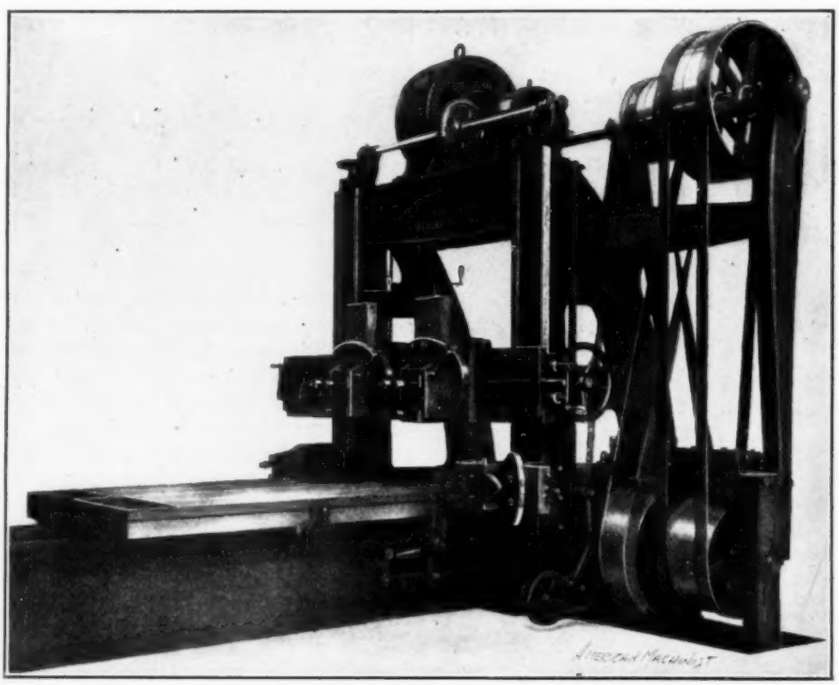
Four Belts for Planer Drives

The acompanying illustration shows the latest development in belt-driven planers by the Pond works of the Niles-Bement-Pond Company. This is a 60-inch planer, carrying a motor on the arch and driving through four belts instead of two.

The increased work that is expected of planers with high-speed tools demands a large belt contact and as a wide belt cannot be shifted satisfactorily for planer-work requirements, they have adopted the plan of two narrow belts instead of one wide belt, which secures the desired driving power and allows the belts to be shifted easily and quietly.

The table is driven by cut gearing in the usual way, the pulleys are of large diameter and proportioned to give a return table speed of 65 feet or more per minute as desired. Two heads on the cross rails and the counterbalanced side heads on upright, have a compound movement and are fed directly from driving gears instead of by friction. Cross-rail heads have automatic variable feeds across, down or at any angle at either end of the cut. These feeds can also be operated by hand from either end of the cross rail, and the side heads have automatic variable feeds in either direction from below the table to the highest point on the cross rail.

The belt-shifter guides are arranged to



60-INCH PLANER WITH 4-BELT DRIVE

shift one pair of belts entirely off the pulley before starting the other pair on, and permit stopping the table instantly from either side without stopping the belt.

A Combination Tool

The tool shown in the line-cut was designed for the use of automobile- and motor-boat owners, etc. It combines 12

A COMBINATION TOOL

tools in one piece as follows: Hammer, tire-lug wrench, cotter-pin puller, gas-tank wrench, wire-insulation scraper, air-tank wrench, spark-plug wrench, alligator wrench, cotter-pin spreader, three screwdrivers and a bottle opener.

This tool is made of drop-forged steel by J. H. Williams & Co., Brooklyn, N. Y.

Inclinable Power Press

The illustrations show the smallest size of a new line of power presses built by T. W. G. Cook, 2 Reade street, New

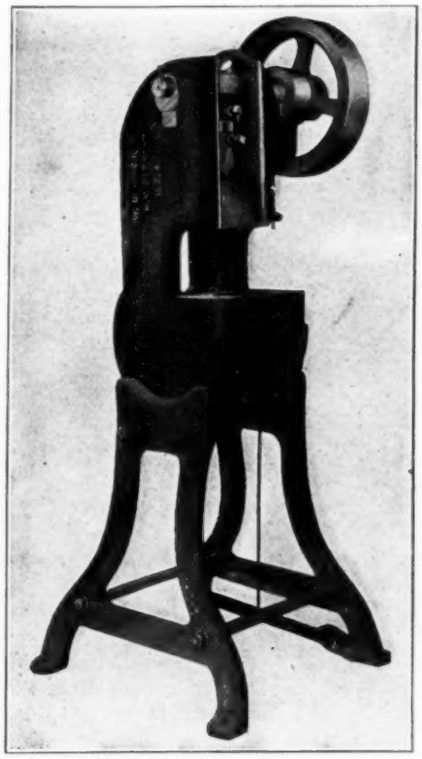


FIG. 1. GENERAL VIEW OF POWER PRESS

York City. These presses are inclinable from vertical to horizontal or to any angle between and the change from one position to another can be quickly made. Another feature of importance is that the

FIG. 2. PRESS SET HORIZONTALLY

shaft has been placed back of the slide, allowing the latter to move in front of it, so as to give a longer slide, and make a straighter guide for the punches and dies and add to the life of the press. The position of the slide is changed by turning a right- and left-hand screw in the pitman. It can be set to 0.001 inch, then fastened with two set screws that act on copper plugs or shoes. Any length of stroke can be made. The clutches are of tool steel, hardened. The press shown is known as the No. 1. The larger sizes have slides 18 and 21 inches long.

The National Steel Reinforced Chuck

The line cut shows a new development which is being applied to independent

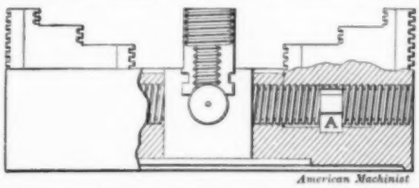


FIG. 1. A CHUCK WITH A STEEL REINFORCEMENT

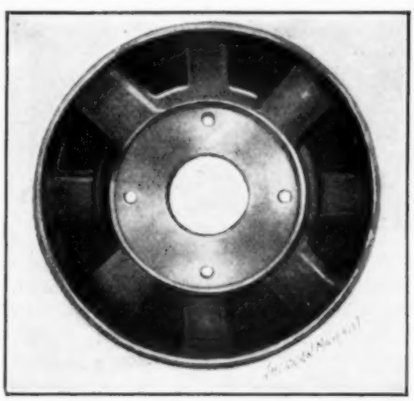


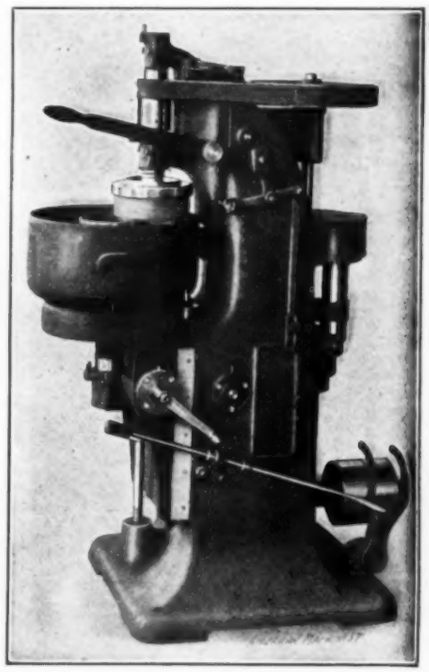
FIG. 2. BACK VIEW SHOWING REINFORCEMENT

lathe-chuck bodies by the Oneida National Chuck Company, Oneida, N. Y. The body is of iron cast around the steel ring *A*. This ring takes the thrust of the screws when gripping both external and internal work and relieves the cast-iron body of these strains. Both ends of the jaw screws have a bearing in the cast-iron body to resist side thrust.

This steel ring also forms a center bearing for the screw as can be seen, and Fig. 2 shows how the ring surrounds the hub of the chuck, adding greatly to its strength.

A Single Stroke Grinder

The illustration shows an interesting vertical-spindle grinding machine by the Walker Grinder Company, Worcester, Mass., and is especially adapted for grinding such work as piston rings, thrust collars, small dies, milling saws and similar work, but it enters very slightly into the field of the larger vertical spindle as it has no cross movement. The action of the machine is controlled by the single lever shown, which starts the work spindle, switches on the electric current for the magnetic chuck and reverses the operation when it is desired to stop, in addition to automatically demagnetizing the chuck in order to allow the work to be removed easily and without scratching.



SINGLE-STROKE GRINDER

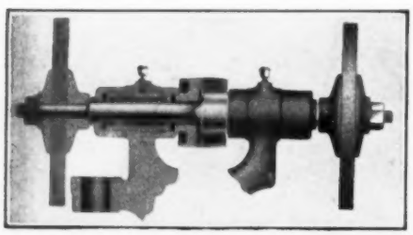
It is the first application of several new automatic electrical features which include the new multi-toothed rotary magnetic chuck having a new system of ventilation by means of a self-controlled motor blower attached to the machine. This is only used on wet grinding machines

for keeping the water entirely out of the chuck to prevent its affecting the insulation. The downward motion of the lever brings the sliding head down against a positive stop which gages the thickness of the work and this throws in a clutch inside the vertical belt drum and automatically throws on the current as well as starts the chuck and work with it.

There is also an improved carbon wheel truing device designed to overcome the usual objections of having the wear come all in one place. This is accomplished by setting the carbon in a stem which is held at an angle so that when a spot has been worn on the carbon it is an easy matter to bring a new point into use by simply turning the stem in the holder. Means are also provided for throwing out the automatic device which turns the chuck so that the carbon truing tool can be used under the wheel. The machines are made for either wet or dry grinding as desired.

A Tool-room and Surface Grinder

The halftones show the construction of the Waterbury grinder which has recently been redesigned. This tool is intended for grinding flat surfaces such as blanking, stamping and piercing dies,



A Toolroom Surface Grinder

punches, lathe and other tools usually done on the ordinary grinder.

The table is 18¼ inches long by 9¼ inches wide, hinged at one end, and supported at the other end by an adjusting screw which gives 1½ inches of fine adjustment. The bracket carrying the table is counterbalanced by a weight inside the column and has a vertical adjustment of 6 inches, permitting the table to be raised to within 3 inches of the spindle center. The end of the spindle opposite to the table is provided with a wheel for ordinary grinding and the regulation rest.

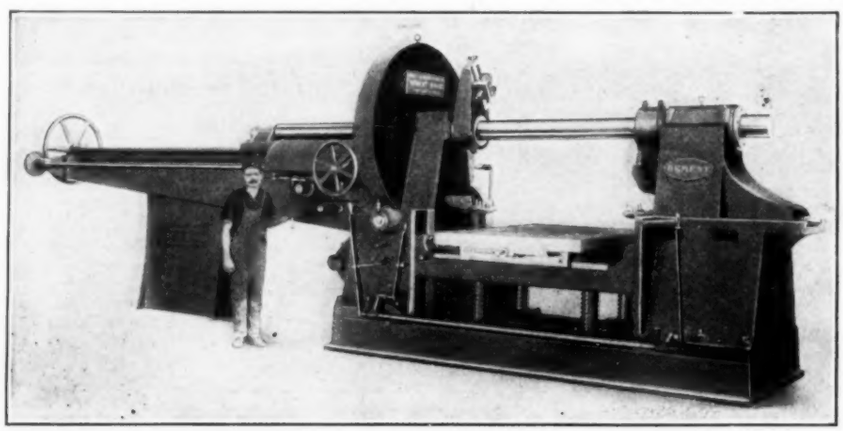
The spindle runs in split conical boxes permitting easy compensation for wear. These boxes, as will readily be seen by referring to the cut, are practically dust proof. A cast-iron tank is attached to the pedestal near the table. A countershaft and two emery wheels, 10x¾-inch, are supplied with the machine.

It is built by the Blake & Johnson Company, Waterbury, Conn.

A Locomotive Cylinder and Piston Valve Chamber Boring Machine

The machine shown in the halftone will simultaneously bore and face both ends of cylinders up to 60 inches in length.

The boring bar is 7 inches in diameter, has a continuous traverse of 11 feet by hand, fast power traverse in either direction, and automatic reversible boring feeds. There are six feeds, dry screw.



A Locomotive Cylinder and Valve Chamber Boring Machine

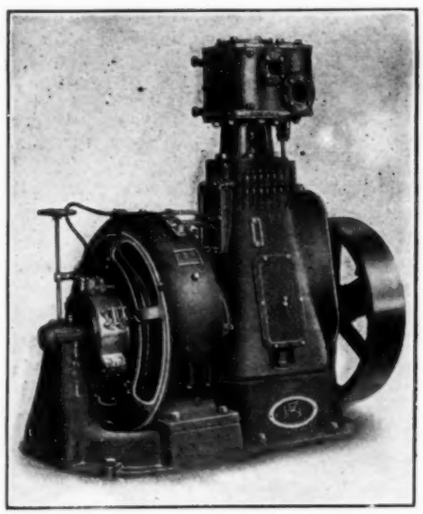
The main table is supported on four elevating screws, the nuts of which are revolved by hand or power. The cross table is 54 inches wide in the direction of the machine's length by 72 inches long transversely. It has a cross traverse of 30 inches and a longitudinal traverse of 18 inches by hand. The minimum distance from center of the boring bar to the table, 30 inches; the maximum, 51 inches. The minimum distance between the facing heads is 20 inches; the maximum, 60 inches.

The drive is by 20-horsepower motor directly geared with reversing controller. Raising and lowering of table and fast traverse to the bar are through this same motor.

This machine is built by the Bement Works, Philadelphia, of the Niles-Bement-Pond, Company, New York.

A New Generating Set

The engine shown in the halftone has been recently brought out by the B. F. Sturtevant Company, Hyde Park, Mass. It is of the high-speed, inclosed type, provided with openings (fitted with dust-proof covers) of sufficient size and in the right positions to permit ready access for inspection or adjustment.



Sturtevant Generating Set

A watershed partition prevents the oil from the frame being carried into the cylinder and the water in the cylinder being carried into the frame. The lubricating system is of the gravity type.

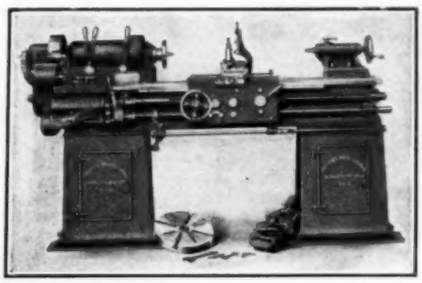
The automatic engines are equipped with the Rites inertia governor adjusted so that the variation in speed between no load and full load is not more than 1½ per cent.

When the engine is to be direct connected to a generator, pump or similar

apparatus, the subbase is extended so that the entire apparatus is attached to the one base.

A 12-inch Lathe

The lathe shown in the halftone is equipped, as shown, with but a single-step pulley. As reverse is provided in the headstock itself, no countershaft is required and it can be belted direct to the line shaft. Eight graduations of spindle speeds are obtainable while the lathe is



PRENTICE ALL-GEARED LATHE

in motion. The quick-change gear mechanism provides 44 changes and screws from 4 to 60 threads per inch can be cut. The lathe can readily be changed from belt to electric drive by bolting a bracket to the rear of the cabinet leg and mounting a motor thereon. This machine is built by the Prentice Bros. Company, Worcester, Mass.

A Cold Sawing Machine

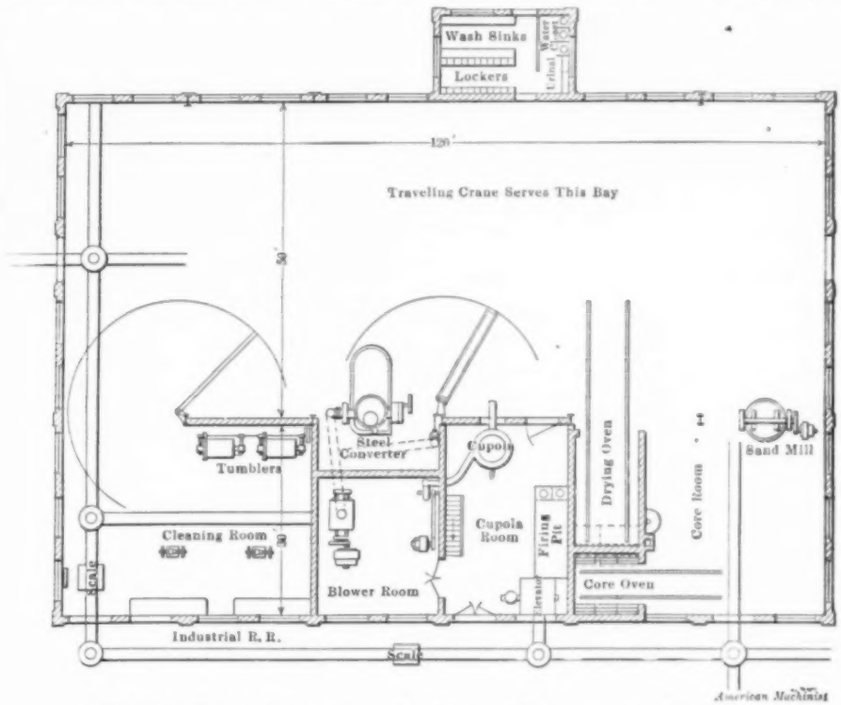
The halftones show front and rear views of a cutting-off saw made by the American Die and Tool Company, Reading, Penn. The drive is by means of spur gearing. The gears on the carriage are forged in one piece with their shafts and are of 60 carbon steel. The large gear is a steel casting. The machine is provided with an automatic spur-gear feed box, giving feeds from ⅛ to 1 inch per minute, all controlled by a single lever. The saw slide is provided with an automatic stop.

The base of the machine forms a reservoir for the lubricant used, which is circulated by means of a geared pump. A flexible metallic tube compensates for the travel of the saw slide.

The driving pulley is arranged with a clutch so that the machine can be driven direct from the line shaft. Should a countershaft be required it is furnished at extra cost. The saw is 18 inches diameter by 5/32 inch thick, and makes 11 turns per minute. The extreme depth of cut is 6¼ inches, and the vise will take 9-inch round stock. The machine occupies a floor space 6 feet long by 2½ feet wide and weighs about 2200 pounds.

New Steel Foundry

We illustrate herewith an interesting layout for what is credited with being the only steel foundry in Canada west of the Great Lakes. This has recently been installed by the Whiting Foundry the Vancouver Engineering Works, Ltd., Vancouver, B. C. It has a capacity at present of eight tons per day and is so designed that extensions for handling double this amount can be made as required and without interrupting the operation of the present foundry. The foun-



PLAN OF STEEL FOUNDRY OF VANCOUVER ENGINEERING COMPANY

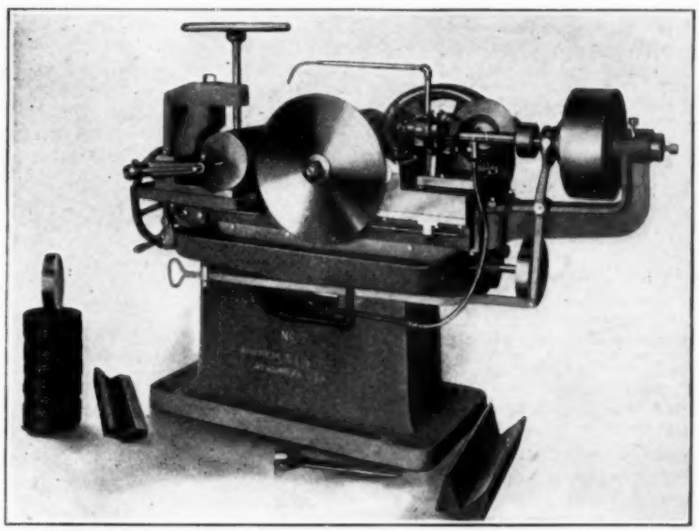


FIG. 1. FRONT OF SAW

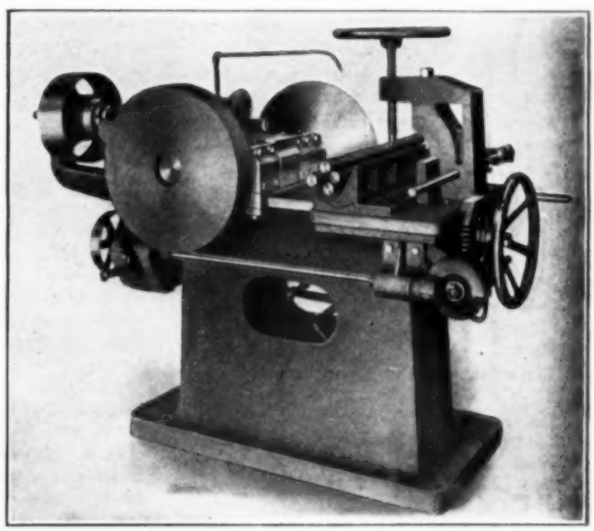


FIG. 2. REAR OF SAW

dry itself is 50x120 feet, while the side bay, which includes the cupola, blower, cleaning, tumblers and core room is 30 feet wide.

This has been designed to provide a very compact arrangement of all the departments, every effort being made to secure a continuous system of handling from the raw material to the finished castings. The cupola is the Whiting No. 4, standing 35 feet from the floor level to the top of the stack, and having a melting capacity of about seven tons per hour. Iron is tapped from the cupola into a 6000-pound ladle and carried by a pneumatic jib crane of four tons capacity to the converter shown at the left, where it is transferred to the converter to be made into steel. The converter has a capacity of two tons and is separated from the remainder of the bay by a steel curtain wall.

The plan shows all of the details very clearly, and it will be noted how the 24-inch gage industrial railway serves the various departments to advantage. A turntable is provided in front of the elevator to aid in sending material to the charging floor and the placing of two scales in the track makes it easy to weigh both the raw material and the finished castings. The main floor is served by a 10-ton traveling crane.

Lytle Bros., Washington, Iowa, will build a garage.

H. Sidles will erect a $20,000 garage at Lincoln, Neb.

The Nucoa Butter Company, Bayonne, N. J., will erect a large factory.

The Iowa Canning Company will erect a factory at Hampton, Iowa.

The Wolverine Brass Works, Grand Rapids, Mich., will extend its plant.

Henry Kerst, Jersey City, N. J., will build a garage on Crescent avenue.

The Prime Steel Company, Milwaukee, Wis., will build a $10,000 addition.

The Willimantic (Conn.) Machine Company may build a new plant.

The Franklin (Ohio) Veneer Mill was destroyed by fire. Loss, $10,000.

The West End Auto Company, Duluth, Minn., will build a $15,000 garage.

The Underwood Typewriter Company, Hartford, Conn., will increase its output.

The Royal Typewriter Company, Hartford, Conn., will build an addition to its plant.

The Larkin Chair Company, South Memphis, Tenn., will build an addition to its plant.

The E. H. H. Smith Silver Company, Bridgeport, Conn., is erecting a $15,000 addition.

The Eastern Underwear Company, Fairfield, Conn., will erect an addition to its plant.

The Kilburn Cotton Mill, New Bedford, Mass., will erect a new mill of 50,000 spindles.

Boynton & Co., Chicago, Ill., manufacturing moldings and carvings, will erect a new plant.

The Bradford (Penn.) Supply Company is in the market for a second-hand radial drill.

The Baron de Hirsch Trade School, New York, will build an addition to its power plant.

The Menning-Slater Company, Des Moines, Iowa, will erect a pickling plant at Nevada, Iowa.

The New York Lard and Butter Company, Bayonne, N. J., will build an addition to its plant.

Mickey Bros. Hardwood Lumber Company will build a $35,000 sawmill in Memphis, Tenn.

The Gray & Prior Machine Company, Hartford, Conn., will spend $5000 in improvements.

The Hoffman Heater Company, Lorain, O., will build an addition to its plant in the spring.

The machine shop of the Eggers Veneer Company, Two Rivers, Wis., was destroyed by fire.

The A. J. Bolton Shoe Company, Rochester, N. Y., will erect a new boiler house to cost $10,000.

The Morrow Machine Company, Hartford, Conn., will make improvements to cost about $20,000.

The Virginia Passenger and Power Company will build repair shops in Manchester, Virginia.

The Hartford (Conn.) Machine Screw Company will erect a new building to cost $150,000.

The Bry-Block Mercantile Company, Memphis, Tenn., contemplate installing a producer-gas plant.

William K. Hamilton, Jersey City, N. J., will erect a factory for the manufacture of sky lights.

The Gering (Neb.) Lumber and Grain Company will build yards and elevators in the spring.

The Electric Garage Company, Omaha, Neb., will build an addition for storage and repair shop.

The Peninsular Stove Company, Detroit, Mich., will build an addition to its plant to cost $71,000.

The Siemon Hard Rubber Corporation, Bridgeport, Conn., will install a new engine in the spring.

The Last-Long Knitting Company, Oswego, N. Y., will erect a new plant and double its present output.

The Wausau (Wis.) Paper Mills Company will rebuild its sulphite mill at a cost of about $100,000.

The Schwarzenback-Huber Company, New York, silk manufacturer, will build a plant at Union Hill, N. J.

The Armbrust Canadian Brake Shoe Company, Ltd., Toronto, Ont., has purchased site for a new factory.

C. A. Dixon Company, Newark, N. J., will build an addition to its machine shop in East Kinney street.

The Armstrong Cork Company, Camden, N. J., is having plans prepared for an addition to its power house.

The plant of Sweet Bros. Paper Manufacturing Company, Phœnix, N. Y., was burned. Loss, about $75,000.

The lumber mill of Follensby & Peck, St. Johnsbury, Vt., was burned, causing a loss of over $17,000.

The Cornwall & Patterson Manufacturing Company, Bridgeport, Conn., will install a new boiler and engine.

The New York, New Haven & Hartford Railroad has purchased site at Stratford for a new power station.

The Lowe Manufacturing Company, Huntsville, Ala., will spend about $80,000 in enlarging its weaving plant.

The Denning Wire and Fence Company, Cedar Rapids, Iowa, is preparing plans for erection of a new plant.

The Hartford (Conn.) Auto Parts Company is installing new machinery at the rate of about $6000 per month.

The Dalton (Ga.) Ice Company has purchased site in North Dalton, on which an ice plant will be erected.

Great West Saddlery Company, Winnipeg, Manitoba, will erect an additional factory in the spring to cost $75,000.

Curtice Bros. Company, Rochester, N. Y., will erect a five-story addition to its canning plant to cost about $50,000.

The Watt Motor Company, Detroit, Mich., recently incorporated with $200,000 capital, has secured site for a plant.

The Diamond Carriage Company, Spokane, Wash., will erect a four-story addition to be used as forge and auto shop.

The Louisville & Nashville Railroad has authorized the erection of a repair plant at Boyles, Ala., to cost $654,000.

Otto Eisenlohr & Bro., 940 Market street, Philadelphia, Penn., will erect a four-story cigar factory at Reading, Penn.

The Syracuse (N. Y.) Wall Plaster Company will build a new factory for the manufacture of cement roofing tile.

The Rickey Machine Company, East Orange, N. J., is erecting a large garage for the storage and repair of automobiles.

Colt Patent Fire Arms Company, Hartford, Conn., will increase its production and bring out several new models of pistols.

John A. Hurley, Incorporated, Bridgeport, Conn., making lanterns and food choppers, will build an addition in the spring.

The Hanlon & Wilson Company, Wilkinsburg, Penn., will erect a factory for the manufacture of vacuum cleaning machines.

The Singer Sewing Machine Company is preparing to establish a veneer factory at Trumann, Ark., to employ 500 hands.

The finishing department of the Mann Edge Tool Company, Lewistown, Penn., was destroyed by fire. Loss, about $100,000.

W. R. Harrison & Co., Massillon, Ohio, whose farm-implement factory recently burned, is preparing to rebuild same.

The Warren Motor Car Company, Detroit, Mich., wishes to contract with some concern for the building of a quantity of motors.

The Fedders Manufacturing Company, Buffalo, N. Y., manufacturing automobiles, radiators, etc., will erect a two-story addition.

The Wm. J. McCahan Sugar Refinery Company, Philadelphia, Penn., will erect an addition to its plant to cost about $250,000.

The Smith Automobile Company, Topeka, Kan., has provided for $100,000 additional working capital. Output will be quadrupled.

The Erd Motor Company, Saginaw, Mich., is now preparing plans for its new plant, having secured the necessary ground for same.

The Hamilton Woolen Company, Southbridge, Mass., is planning to build an addition to its weave shed, also a large power station.

The Turner & Thomas Manufacturing Company, Chicago, Ill., contemplates adding 30 power-punch presses to its factory equipment.

M. V. Cheesman & Co., Mishawaka, Ind., manufacturing heavy sheet iron and structural steel, are adding a foundry to their plant.

Fire destroyed Mill No. 2 of the Wasp Mining Company on Yellow river creek, about six miles from Deadwood, S. D. Loss, about $50,000.

The plant of the Consolidated Ice Company, East Liberty, Penn., was damaged to the extent of $25,000, caused by collapsing of walls.

The Crissey-Fowler Lumber Company, Colorado Springs, Colo., will erect a new planing mill to cost about $10,000, including machinery.

The Paris (Ky.) Electric Light Company will increase the capacity of its plant. New engines, generators and boilers will be purchased.

The John C. Kupferle Foundry Company, St. Louis, Mo., has secured a permit for the erection of a new foundry, which is to cost $100,000.

The Union Pacific Railroad will move its shops from Cheyenne and locate them in the shops now occupied by the Pullman Company in Denver.

The Buena Fe Mine, Ojuelos, Jalisco, Mex., is constructing a 20-ton mill. Machinery purchased, but plant will probably be enlarged later.

The General Castings Company, Verona, Penn., which has been shut down since December, 1907, will resume operations about February 15.

The Elizabeth City (N. C.) Hosiery Company contemplates the erection of an addition and installing machinery for a new line of cotton hosiery.

J. N. Willys and Mr. Morrow, of the Morrow Manufacturing Company, Elmira, N. Y., are about to engage in the manufacture of automobile parts.

Firestone Tire and Rubber Company, Akron, O., contemplates the erection of an addition to its plant, to cost, with equipment, nearly $1,000,000.

The cracker-box plant of the Evan Reed Manufacturing Company, Sterling, Ill., was practically destroyed by fire, causing a loss of about $20,000.

The Marvel Crude Oil and Hydro Gas Burner Company, Oklahoma City, Okla., has commenced erection of a factory at 108 West Washington street.

The American Brake Shoe Foundry Company, Chicago, Ill., has purchased site with the view of constructing a new plant some time in the future.

The White Automatic Incubator Company, Eugene, Ore., has purchased a building to be equipped with new machinery for the manufacture of its product.

Danbury & Bethel Gas and Electric Light Company, Danbury, Conn., is in the market for a 1500-horsepower turbine engine to be installed in the spring.

It is reported that Longyear & Hodge, Marquette, Mich., are planning to erect a plant for the manufacture of diamond drills and other mining machinery.

The Case Crane Company, Columbus, Ohio, will spend $10,000 in additional machine-shop equipment, to include milling machines, shapers, radial drills, lathes, etc.

The Tirill Manufacturing Company, Schenectady, N. Y., is said to be negotiating for a site in Worcester, Mass. The company manufactures electrical appliances.

The Geiser Manufacturing Company, of Waynesboro, and New Castle, Penn., building engines, pumps, threshers, etc., will probably establish a plant in Trenton, N. J.

W. C. Finber, architect and engineer, 420 Walnut street, Philadelphia, Penn., will prepare plans for a six-story leather belting factory for Alexander Bros., Philadelphia.

The Adamson Machine Company, Akron, O., has completed the erection of a machine shop. Drop hammer and cranes installed. Will probably need more equipment as business grows.

The Passaic Structural Steel Company has been formed to take over the plant of the Passaic Steel Company, at Paterson, N. J., recently sold under direction of the Chancery court.

The Morris-Small Company, formed at Macon, Ga., will erect a plant at Columbus for the manufacture of sewer pipe. W. Mercer Morris, R. B. Small are among the incorporators.

The United States Steel Corporation will build an addition to the plant of the Universal Portland Cement Company, at Bluffington, Ind., for which $1,500,000 has been appropriated.

Fire destroyed the nine buildings composing the plant of the Edison Manufacturing Company, at Silver Lake, Bloomfield, N. J. Plant was used for the manufacture of storage batteries.

The Page Woven Wire Fence Company, Monessen, Penn., is considering extensive improvements, including making its own billets, which will mean the erection of an open-hearth furnace.

The Kinglyte Manufacturing Company will open up a new factory in a few weeks at 219 Court avenue, Des Moines, Iowa, for the manufacture of lighting appliances. About $10,000 will be invested.

J. V. Poley, engineer, Royersford, Penn., is preparing plans for an underwear mill to be erected at Spring City, Penn., for the National Underwear Company. Equipment will be purchased by owners.

The Great Western Manufacturing Company, La Porte, Ind., is planning the erection of an addition to its plant. Besides manufacturing bicycles, the concern will engage in the manufacture of motorcycles.

The Toledo (Ohio) Electric Welding Company has increased its capital to $75,000, and will move to Cincinnati, Ohio, where a factory has been leased. Full line of electric welding machines will be built.

Welsh, Sturdevant & Poggi, Coal Exchange building, Wilkes-Barre, Penn., are preparing plans for a bottling house to be erected at Nanticoke, Penn., for the Stegmaier Brewing Company, Wilkes-Barre, Penn. Owners will purchase equipment.

The Milwaukee-Western Railway, Majestic building, Milwaukee, Wis., will soon let contracts for the construction of a new 2000-horsepower steam-electric plant at Hustesford, Wis. W. D. Chapman, Marquette building, Chicago, is engineer.

The United States Light and Heating Company, 30 Church street, New York, will erect a plant at Niagara Falls, N. Y., for the manufacture of car-lighting equipment, including generators, regulators, storage batteries, etc. Dodge & Day, of Philadelphia, Penn., are preparing plans.

The Champlin & Norton Manufacturing Company, Plainville, Conn., will establish a plant for the manufacture of electrical specialties. This is a new concern capitalized at $10,000. F. A. Champlin, of Longmeadow, Mass., is president, and M. A. Norton, Plainville, secretary.

The Los Angeles (Cal.) Investment Company has purchased ground on which a large plant will be erected to house the different factories and mills owned by the company. About $250,000 will be spent. Additional uptodate machinery and devices of home building will be installed.

The International Steel Tire Company, Altoona, Penn., at its annual meeting, decided to place stock to the amount of $50,000 on the market for the purpose of establishing the necessary plants. The assembly factory at Johnstown is under way. Site for fastener factory has not yet been settled.

The International Tool Steel Company, incorporated under Ontario Companies Act for the purpose of manufacturing edge tools, cutlery, etc., and will probably locate its plant in Welland, Ont. Manson Campbell, president of the Chatham (Ont.) Wagon Company is one of the incorporators.

The Mitchell Motor Company has filed incorporation papers at Madison, Wis., being a consolidation of the Mitchell & Lewis Company, Ltd., manufacturing wagons, and the Mitchell Motor Company, making automobiles, both of Racine. The new company will make extensive additions to existing plants.

The Columbia Cotton, Oil and Provision Company, Relee, Va., will erect an addition to its power plant, also increase refrigerating capacity by about 100 tons. 100-kilowatt generator set, two 450-horsepower boilers with superheaters will be installed. Will also build an abattoir to cost about $150,000.

The Pittsburg Steel Products Company, Monessen, Penn., recently organized to take over the property of the Seamless Tube Company, will branch out in other lines of manufacture. The plant will be enlarged and reinforced. Concrete steel products, steel telephone poles, automobile axles will be made.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 4, for electric blueprinting machine, vertical fire-tube boilers, horizontal tension carriage, idler wheels, rubber belting, valves, pipe fittings, machinists' taps, pipe cutting and threading machine, etc., as per Circular No. 556.

The Lorenson Manufacturing Company has secured a building in Rock Island, Ill., at Third avenue and Fourth street, for the manufacture of a field mower invented by Carl Lorenson, who has been making same on a small scale in Davenport. A foundry adjoining the building is to be built. The new company is capitalized at $50,000.

J. J. Carroll and Chas. Van Brandais have an option on electric-light plant of Durango, Dgo., Mexico, and are now negotiating to raise funds. It is the intention to increase the capacity of the plant. Julio Guerreo is present superintendent. Plans are also being made to change the motive power of the street railway from one mule to electricity.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: February 8—Miscellan-

eous equipment for power plant (schedule 2174), engine lathe (schedule 2173), propelling machinery for gasolene barges (schedule 2172), pipe-thread and cutting machines (schedule 2170), oxy-acetylene welding and cutting plant (schedule 2171); February 15—Twist drills, galvanized sheet steel (schedule 2168).

The University of Iowa, Iowa City, Iowa, will purchase machinery as follows for new engineering buildings in October or November. Prof. B. Fleming will have charge of purchasing: 36x36-inch planer, 3-inch radial drill, vertical turret machine, universal grinder, 18-inch turret lathe, horizontal boring mill, tool-room lathe, complete iron cupola, brass furnace, molding machine, jib crane and other foundry equipment, forging machine, air bulldozer, punch and shears, small steam or power hammer, bolt-heading machine, oil or gas furnace, oil-welding furnace, 150-pound anvil, and equipment for forge shop.

NEW INCORPORATIONS

Redington Rock Drill Company, Ltd. Capital, $250,000. R. W. Leonard, St. Catharines, Ont., president.

Port Arthur Wagon Company, Ltd., Port Arthur, Ont. Capital, $750,000. Masten, Starr & Spence, Toronto, solicitors.

Natchez Packing Company, Natchez, Miss. Capital, $100,000. Incorporators, J. N. Carpenter, A. G. Campbell, S. H. Lowenburg, etc.

Dominion Corrugated Steel Pipe Company, Ltd., St. Johns, Province of Quebec. Capital, $20,000. Incorporators, Cecil H. Richardson, etc.

Standard Automobile Company of America, Wabash, Ind. Capital, $500,000. Incorporators, G. J. Kobusch, W. S. McCall, A. R. Walton, etc.

Sawyer-Massey Company, Ltd., Toronto, Ont. Manufacture steam, gasolene and oil engines and farm implements. Capital, $7,000,000.

Canadian Automatic Air and Steam Coupler Company. Capital, $700,000. Incorporators, Peter A. Senecal, Winnipeg, Manitoba, and others.

Peerless Leather Works, Irvington, N. J. Manufacture leather. Capital, $10,000. Incorporators, George A. Kuhn, Harry Schlesinger, M. S. Kuhn.

Glass Products Company, Newark, N. J. Manufacture glass bottles, etc. Capital, $50,000. Incorporators, J. F. Sisserson, J. A. Allen, H. L. Burrows.

Houston Metal Furniture Company, New York. Metal office furniture. Capital, $25,000. Incorporators, E. J. Forhan, J. J. Harper, G. F. Martin.

Hemming Bros. Company, New Haven, Conn. Manufacture machinery and tools. Capital, $10,000. Incorporators, O. L. Hemming, R. B. Hemming, Carl H. Hemming.

Kurz Machine Company, Quincy, Ill. Manufacture and deal in machinery, motors, etc. Capital, $11,000. Incorporators, Wm. Kurz, L. J. Weisenhorn, Frank Koetters.

Post Lock Register Company, New York. Manufacture taxicabs and lock registers for same. Capital, $150,000. Incorporators, T. W. Post, G. W. Moore, C. Colgate.

Defender Manufacturing Company, Cincinnati, Ohio. Manufacture machinery. Capital, $15,000. Incorporators, Chas. E. Holland, T. H. McSweeney, R. P. Buchwalter, etc.

The Bliven Manufacturing Company, Putnam, Conn. Manufacture trolley-car equipment. Capital, $50,000. Incorporators, P. C. Bliven, A. J. Hall, J. Bodo, Danielson, Conn.; G. H. Gilpatric, Putnam.

Standard Steel Company of New Jersey, West Hoboken, N. J. Manufacture high-speed tool steel, etc. Capital, $15,000. Incorporators, A. Wolfson, 215 Shippen street, M. Rosenthal, 543 Angelique street, Weehawken, etc.

J. H. Deppeler Company, 819 Jersey avenue, Jersey City, N. J. Autogenous welding and brazing and manufacture tanks and sheet-metal work. Capital, $20,000. Incorporators, J. H. Deppeler, East Orange; J. A. Carmody, Newark, etc.

TRADE CATALOGS

Becker Milling Machine Company, Hyde Park, Mass. Circular illustrating and describing Aetna three-way vise.

Wm. J. Smith Company, New Haven, Conn. Catalog describing one-lock adjustable reamer. Illustrated, 12 pages, 3½x6 inches, paper.

A. Hun Berry, 23 West First street, Boston, Mass. Catalog describing Berry ventilating wheel. Illustrated, 28 pages, 3½x5½ inches, paper.

The Cincinnati Tool Company, Cincinnati, Ohio. Catalog of drills, pliers, screw drivers, augers, clamps, etc. Illustrated, 50 pages, 7x10 inches, paper.

Doehler Die-Casting Company, Court and Ninth streets, Brooklyn, N. Y. Catalog of die castings. Illustrated, 16 pages, 3½x6 inches, paper. Circular illustrating and describing oil cup.

The Cleveland Punch and Shear Works Company, Cleveland, Ohio. Hand Book and Stock List of machines and small tools for the fabrication of iron and steel. Illustrated, 56 pages, 4x7 inches, paper.

BUSINESS ITEMS

The Wagner Electric Manufacturing Company, of St. Louis, announces the opening of a district office in Detroit in the Union Trust building, Room 509, in charge of A. B. Hoffman.

The Covington Machine Company, Covington, Penn., has made arrangements with the Wiener Machinery Company, New York City, whereby the latter concern will be in charge of its eastern sales office.

Henry Disston & Sons, Inc., Philadelphia, Penn., have recently opened branch houses in Seattle, Wash.; Portland, Ore., and Vancouver, B. C., to better facilitate filling orders. This company recently erected a new factory building at Toronto, Canada.

F. A. Hall, formerly manager of the hoist department of Yale & Towne Manufacturing Company, has been made vice-president and treasurer of the Cameron Engineering Company, 150 Berriman street, Brooklyn, N. Y., manufacturer of ball-bearing trolleys, hangers, etc.

FORTHCOMING MEETINGS

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

American Society of Mechanical Engineers; monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Mechanical engineer and superintendent wants position as traveling salesman, machine tools or similar line; opportunity of more importance than salary. Address Box 135, AMERICAN MACHINIST.

ILLINOIS

High grade cost accountant; 10 years' experience; good executive; A-1 references; location not material. Box 132, AMER. MACH.

First-class tool designer wants position getting out dies, jigs and fixtures for light automatic machinery or metal specialty work; prefer Chicago or vicinity. Box 116, AM. MA.

Mechanical draftsman with eight years' practical workshop experience and well posted in workshop practice and with nine years' drafting on general engineering work, machine tools and special machinery and fixtures for economical production, wants position as assistant superintendent. Box 152, AMER. MA.

INDIANA

Wanted—Position by first-class machine shop and tool room foreman; 25 years' experience on special machinery and tools; last 12 years as foreman and assistant superintendent; age 39; married; best references. Box 153, AMERICAN MACHINIST.

MASSACHUSETTS

Correspondence solicited from parties desirous of securing the services of a high grade mechanical factory manager. Box 118, AM. M.

Draftsman—Experienced, rapid, accurate, desires change, preferably, but not necessarily, in country town or small city of New England. Box 143, AMERICAN MACHINIST.

Young man of practical experience in cost work, desires position with a large manufacturing concern; experienced in printing presses, steam heating apparatus, electric cars, automobiles, gasolene engines; also general foundry and machine work; good references. Box 169, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman, experienced in power plant design, high pressure steam and condenser work; best references. Box 158, AM. M.

HEATING a SHOP THROUGH ITS FLOORS

A Novel and Successful System with no Registers, Coils, Pipes or Radiators

EDITORIAL CORRESPONDENCE

No steam or hot-water radiators, no heating coils, no hot-air registers—the absence of these usual devices for heating a shop is the striking engineering feature of the buildings of the new plant of the Morse Chain Company, at Ithaca, N. Y. The foregoing sentence indicates an experiment in shop heating and a successful experiment it has been; yet the average heating and ventilating engineer would hesitate to try any kind of a heating experiment in a plant located and exposed as are the buildings shown in our halftone illustration, Fig. 1. The exterior walls of all these buildings are either of concrete blocks or monolithic concrete, in which the aggregate is crushed stone, a native slate quarried on the spot in preparing the foundations.

FIG. 1. PLANT OF MORSE CHAIN COMPANY, ITHACA, N. Y.

The city of Ithaca was located on the plain, at the southern end of Cayuga lake, and having outgrown this level site it has spread itself upon the surrounding hills; near the crest of a hill that swings around to the westward overlooking the plain below and the inlet of the lake is this new plant of the Morse Chain Company, finished and occupied early in the year 1906. As a beautiful site, with wonderful natural scenery, it surpasses any other site that we have ever seen used by a manufacturing plant. In fact, the natural development would seem to have been a country estate or sanitarium rather than a machine shop.

As regards the heating problem that we are to consider, from its location on the hill above the lake and from its exposure, which is toward the north and west, the buildings receive the full force of the winters' northwestern winds in a climate where the thermometer frequently registers 10 degrees Fahrenheit below zero, and where every winter brings a plentiful fall of snow.

STEPS IN DEVELOPING THE SYSTEM OF HEATING

It is interesting to follow the various steps in the development of this system of heating. The former plant of the Morse Chain Company was at Trumansburg, N. Y., and was heated in the usual manner, by an indirect system; that is, the blowing of hot air into the shops. The pattern shop was equipped with the customary glue pot heated by steam. The drip from this pot, as a mere matter of convenience, was carried through the floor and the condensed water was allowed to leach away into the gravelly soil. As a result of this arrangement, a small section of floor space around the glue pot was heated by the steam and hot water that escaped into the ground beneath. Mr. Morse noticed that this particular section of floor space was a favorite gathering place for the men; for those working in the pattern shop in working hours and others from the machine shops during the noon hour, when eating their lunches and having their after-dinner chat.

It became necessary to extend the pattern shop at Trumansburg and, following the observations made in connection with the glue pot and its waste steam and water, a system of 1-inch wrought-iron pipe was laid in the floor of the new pattern shop and connected back to the drip from the glue pot by a suitable system of valves. This system was put in with two ideas. A section of heated floor space would be of service in drying out the built-up wheel-pattern sections after they had been glued; at the same time, it was believed that the arrangement would serve as a satisfactory way to heat the shop. This shop was a roofed-over court between two main buildings. Aside from the heat which would be communicated to the floors from the system of pipes, no other provision was made for heating the room, except to make a few openings whereby air from the plenum of the main shop could enter.

This experiment was successful. Not only were the patternmakers satisfied with the method and degree of warming, but men from the machine shops would frequently come into the pattern shop to get warm, when the temperature of the air at about the level of a man's eye was 20 degrees less in the pattern shop than in the machine shop. There is an old adage in regard to health that runs something like this: "Keep your head cool and your feet warm." This system accomplished exactly that result; the men's feet were warmed from the warm floor, while the upper part of the room was

much cooler than if the system of heating had been by direct or indirect radiation. Their feet were kept warm and their heads were kept cool.

Heating of the Ithaca Plant

Three modifications of this system of heating through the floors are in use at the Ithaca plant. The pattern shop is heated by exhaust steam, traversing wrought-iron pipes laid in the concrete floor. The main machine shop is heated by hot air, forced through a system of supply and return ducts built in as part of the concrete floor structure, and the blacksmith shop is heated by a circulation of hot flue gases through a system of tile pipes buried some little distance below the floor of the shop. We will describe each of these systems in some detail, beginning with the pattern shop,

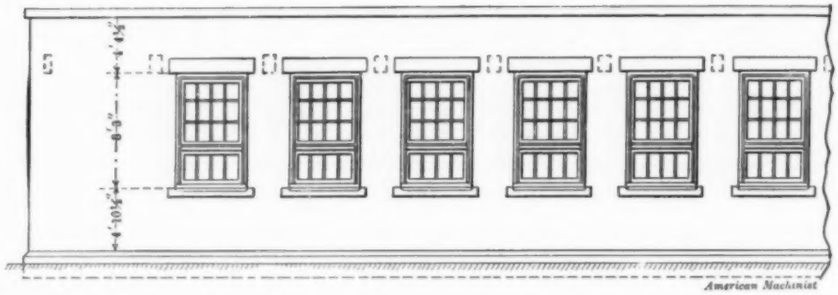


Fig. 3. Partial Elevation of Pattern Shop

as that is the simplest installation and more directly follows the successful experimental system at Trumansburg.

Heating the Pattern Shop Through the Floor

Fig. 2 shows the ground-floor plan of the pattern shop, with the piping system for heating, while Fig. 3 shows a partial elevation of the building, giving its height, windows and general exterior details. This building is some 80 feet long, 22 feet 8 inches wide, and has a cubical content of 32,250 cubic feet. The walls are of monolithic concrete; the roof is of 3-inch plank, covered with composition roofing and the building is isolated, except for the southern end, where it joins a lumber-storage and a pattern-storage building. In fact, a portion of this end abuts on an open, though covered court. Along the western wall is a 3-inch exhaust-steam supply main; 1-inch pipes tap from this main run across the building, turn and run parallel with its length for a distance of about 5 feet, then turn again, cross the building again and enter a 2-inch return main that runs the length of the building on the same side as the supply main. The 3-inch supply main is at a level of about 1 foot above the floor. The crosswise runs pass through 4-inch wrought-iron pipe buried in the concrete floor, with a covering of about ½ inch of floor-wearing surface. The 5-foot runs lengthwise of the building are in an open gutter against the exterior wall; this gutter is covered with boards. Similarly the 2-inch return main is in a gutter along the opposite wall. The only exposed radiation in the room is the 3-inch supply main.

The total amount of radiating surface is 310 square feet, distributed as follows: Eighteen 1-inch pipes, 28 feet long, 161.4 square feet of surface; nine 1-inch pipes, 5 feet long, 15.5 square feet of surface; one 3-inch pipe, 84 feet long, 80 square feet of surface; one 2-inch pipe, 84 feet long, 52.5 square feet of surface, giving a total of 309.4, or, say, 310 square feet of radiating surface. Of this the 3-inch

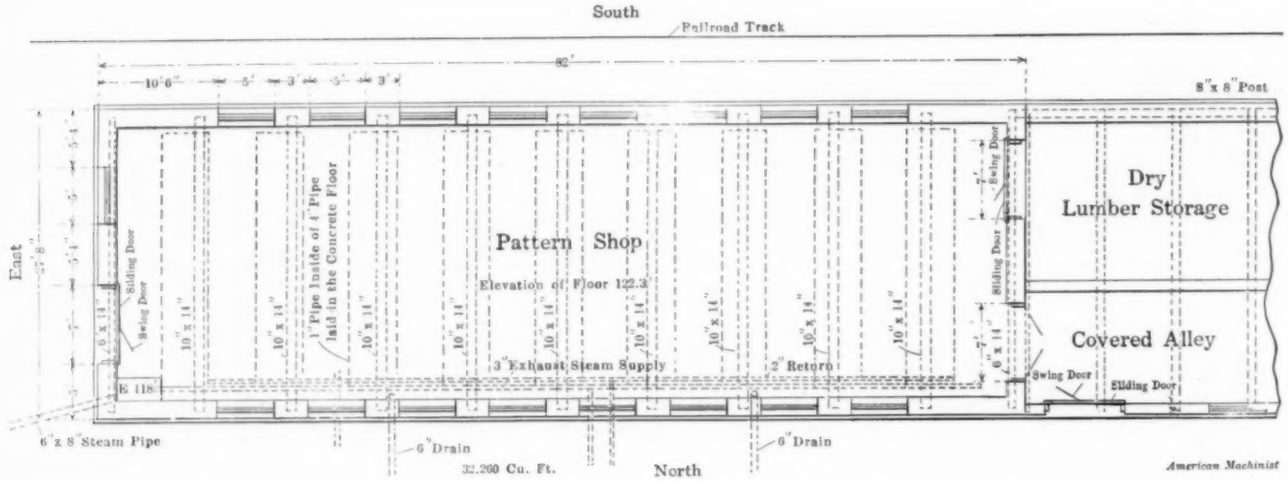
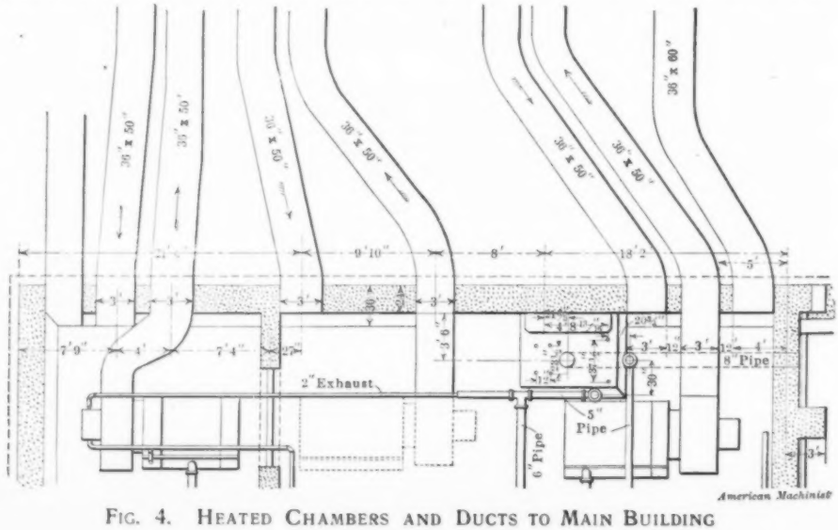


Fig. 2. Plan of Pattern Shop Showing System of Heating Pipes in the Floor


36" x 50"
36" x 50"
36" x 50"
36" x 50"
36" x 50"
36" x 50"
36" x 60"
9'10"
8'
18'2"
5'
3'
3'
3

main, or 80 square feet, is in the room itself, while the balance, 230 square feet, is in the floor.

The cubical contents of the shop are 32,250 square feet, giving approximately 104 cubic feet of volume per square foot of exterior pipe radiating surface.

A familiar heating factor frequently quoted in connection with factory buildings is that 1 square foot of direct radiation surface should be provided for 75 to 100 cubic feet of volume, with the accompanying note that isolated buildings exposed to prevailing northerly or westerly winds should have a generous addition made for their exposed sides. The factors are for latitudes where the minimum temperature range is minus 10 degrees Fahrenheit. Accepting these factors, we see that the amount of radiation provided to heat this pattern shop through the floor is slightly less than the minimum indicated for factory buildings that are not unusually exposed to severe winds or low ranges of temperature.

The steam pressure used is about 2 pounds back pressure. The following table shows the floor temperature, the temperature about the level of a man's eye and the temperature just under the roof, from observations made when the external temperature was zero and the prevailing wind was blowing from a northwest direction with a velocity of about 30 miles per hour. This shows what the system is capable of accomplishing. The lower part of the room as a whole is the warmest; that is, the part of the room where the men are at work. Again, behind these records stand three winters of successful use with the workmen perfectly satisfied with the temperature and conditions maintained.

January 4, 1910, minimum external temperature, 5 degrees below zero, maximum 11 above zero. Wind northwest 20 to 40 miles per hour.

PATTERN SHOP TEMPERATURES.
Temperature taken between heating pipes.

	7 a.m.	10 a.m.	1 p.m.	6 p.m.
1 inch above floor.	48°	52°	58°	59°
7 feet above floor.	48°	52°	58°	59°
Under roof.....	49°	53°	58°	60°

Temperature over pipes 1 inch above floor same day 7 a.m., 52° to 60°.

Heating the Main Shop Through Floors

The heating system of the main shop differs from the pattern shop in that it uses a circulation of hot air through ducts instead of a circulation of steam through pipes. Two heaters are installed, with space provided for a third (see Fig. 4), where the location for the third heater is indicated by dotted lines. The two that are installed are shown in full lines together with the system of supply and return ducts. The provision for a third heater is made to care for growth of the plant, as the two heaters now installed are more than ample for all the requirements of the main machine-shop building.

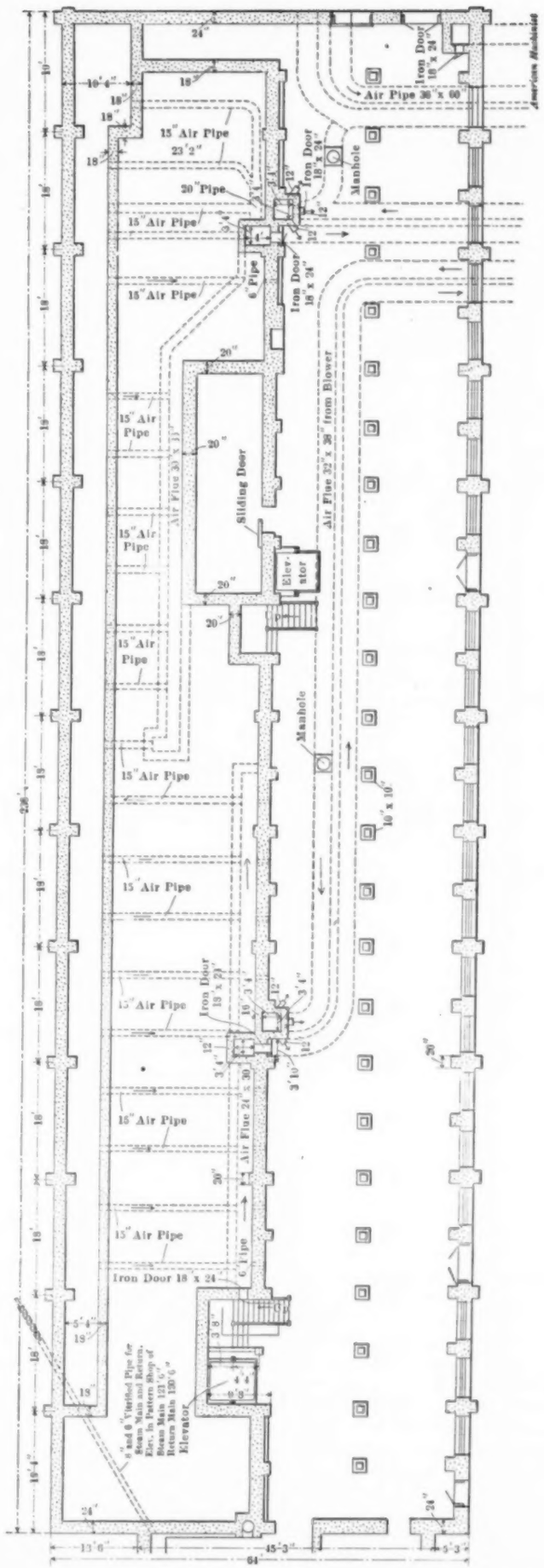

Iron Door 18" x 24"
Air Pipe 36" x 60"
15" Air Pipe
23'2"
Manhole
20" Pipe
6" Pipe
Air Flue 32" x 36" from Blower
Sliding Door
Air Flue 30" x 35"
Elevator
Manhole
10" x 10"
Air Flue 24" x 30"
6" Pipe
Iron Door 18" x 24"
6" and 8" Vitrified Pipe for Steam Main and Return, Etc., in Pattern Shop of Steam Main 125'6" Return Main 130'6" Elevator
64'

Fig. 5. Basement Plan of Main Building Showing Ducts and Pipes Beneath the Floor

Fig. 5 shows the basement plan of the machine shop. The point of entrance of the ducts will be seen in the lower right-hand corner. The supply ducts connect with large chambers forming vertical flues at various points as seen on the drawing, and these in turn connect with a system of 15-inch tile bell-and-spigot pipe laid with portland-cement joints. These pipes are directly under the concrete floor and cross the building to a point some 5 feet from the eastern wall, where they enter a large concrete duct running the full length of the building.

Fig. 6 shows a cross-section of the machine shop, which will be observed to consist of a crane floor, shown at the right, a main floor at the left, a gallery floor above the main floor, and below a basement.

Fig. 8 shows a section through a concrete duct entering a vertical flue and this in turn connecting into the 15-inch pipes that have been mentioned. Fig. 7 shows a galvanized-iron pipe with openings, two of which are located at such a level as to discharge air into the basement, two onto the main floor and two

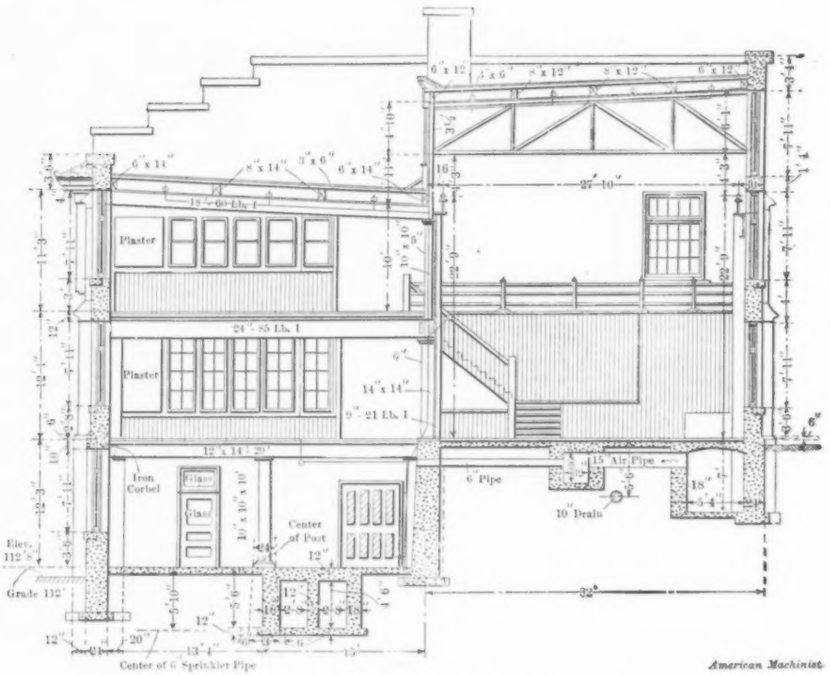


FIG. 6. SECTION THROUGH MAIN BUILDING

From this duct other 15-inch tile pipes run back to the return flues and thence to the large return duct that conveys the circulating air back to the fans. A study of the detail shown in Fig. 5 will make this system clear.

In passing it is worth while to note that the long duct near the eastern wall serves as a space for a long line of shafting from which the machine tools under the crane are driven through the floor by means of chains. A small amount of air finds its way through the belt or chain openings into the shop, but otherwise the circulating system is an inclosed system provided dampers in two vertical heating stacks, to be mentioned later, are closed. A system of butterfly dampers is installed in the large heating ducts, so that any duct can be changed from a supply duct to a return duct at will, as the needs of operating the system demand. Returning now to the right-hand end of Fig. 5, two of the ducts will be seen to end at the wall of the building. A continuation of these ducts will provide for the heating of an extension to the factory when such is built.

onto the gallery floor. These two stacks are the only provision made for distributing heated air directly through the room. When these two pipes are closed off, as is the case under ordinary shop conditions, even in the severest weather, no heated air comes directly into the machine shop, except such air as filters through the belt holes from the large duct along the eastern wall.

Turning now to the number of cubic feet of volume per square foot of indirect radiating surface; of the two heating plants one has coils with a combined heating surface of 2500 square feet; the other is larger, having a heating surface of 4840 square feet, giving a total of 7340 square feet for both.

The cubical contents of the main machine shop building, including the basement, is 514,500 cubic feet. This quantity divided by 7340 total area of radiating surface in both heater coils, gives a factor of 70 cubic feet of machine-shop volume per square foot of indirect radiating surface.

As a matter of fact, both fans are not used on heating this building except in severe weather and between the hours of 4 and 7 a.m. at which time the two vertical galvanized-iron pipes are employed and the air is recirculated before the workmen enter at 7 a.m. At that time the vertical stacks are cut off, the smaller heating plant is shut down and throughout the balance of the day the shop is warmed from the larger heating plant and entirely through the ducts and vitrified pipes beneath the floor. Dividing the cubical volume of the entire shop by the heating area of the larger plant, that is, 514,500 cubic feet by 4840 square feet, gives a factor of 106 cubic feet of volume per square foot of indirect heating surface. This is the factor that prevails under ordinary shop running conditions.

A frequently quoted factor for the amount of indirect radiation needed for factories in latitudes where a minimum temperature is 10 degrees Fahrenheit is from 50 to 70 cubic feet of volume per square foot of indirect radiation. The note quoted in connection with the pattern-shop factors applies here as well, and provides that isolated buildings, exposed to northerly or westerly winds should have a generous addition made to their heating provision for the exposed sides. The higher factor given is 70 cubic feet of volume per square foot of radiation. If this is compared with the factors worked out, namely 70 cubic feet of volume per square foot of indirect radiating surface when the plant is being warmed and 106 cubic feet during the day when the plant is in use, it will be seen that this floor system of heating requires no additional amount of heating

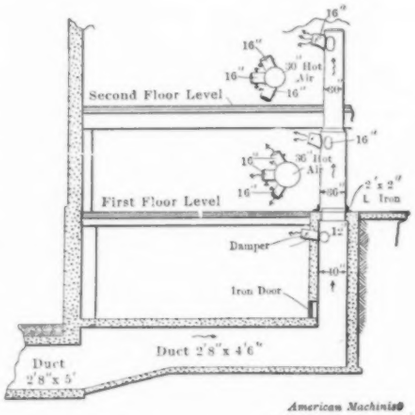


FIG. 7. SECTION THROUGH HOT-AIR STACKS

surface over accepted practice for other systems. In fact Mr. Morse states that the heating companies called for about double the radiating and fan capacity that he has installed. The success of the system is attested to by satisfactory use during the last three winters and the range of temperatures throughout the building compared with the outside temperature is shown by the following brief tabulation:

Temperatures were taken at a point 4 feet above each of the floors on Saturday January 8, 1910, the outside temperature at 7 a.m. being 4 degrees Fahrenheit; wind northwest, 6 miles per hour.

	7. A.M. Degrees.	12 M. Degrees.	6 P.M. Degrees.
First floor.....	62	59	64
Second floor.....	62	63	69
Third floor.....	64	67	73

The Blacksmith Shop

Fig. 9 shows a sectional plan of the blacksmith shop, which is heated by means of flue gases. Turning to this section, a No. 8 Sturtevant exhauster is indicated just below the level of the roof trusses. This exhauster sucks the flue gases from a large number of furnaces and forges and also draws a certain amount of air from the room itself through the space between the forge outlines and superimposed hoods. Under ordinary conditions this exhauster discharges directly through the roof by means of the short section of stack. In severe weather, however, a damper is closed, the heated flue gases are discharged through the pipe that follows the contour of the roof passing down to the ground. Turning to the plan it will be seen that the pipe running down to the ground is indicated as 18 inches in diameter. Flush with the level of the ground is the bell of a T having one outlet on the run 18 inches in diameter and the other 15 inches in diameter. This T and the connecting pipes are vitrified tile sewer pipe. Starting at this T the pipe runs in both directions around the shop near the exterior walls and discharges at one corner as shown. Through this piping the flue gases pass during cold weather and thus thoroughly heat the floor or ground in the blacksmith and forge shops. It is surely a simple, easy system to install and inexpensive to operate.

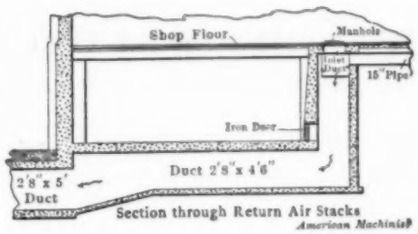


Fig. 8. Section Through Duct, Flue and Tile Pipe

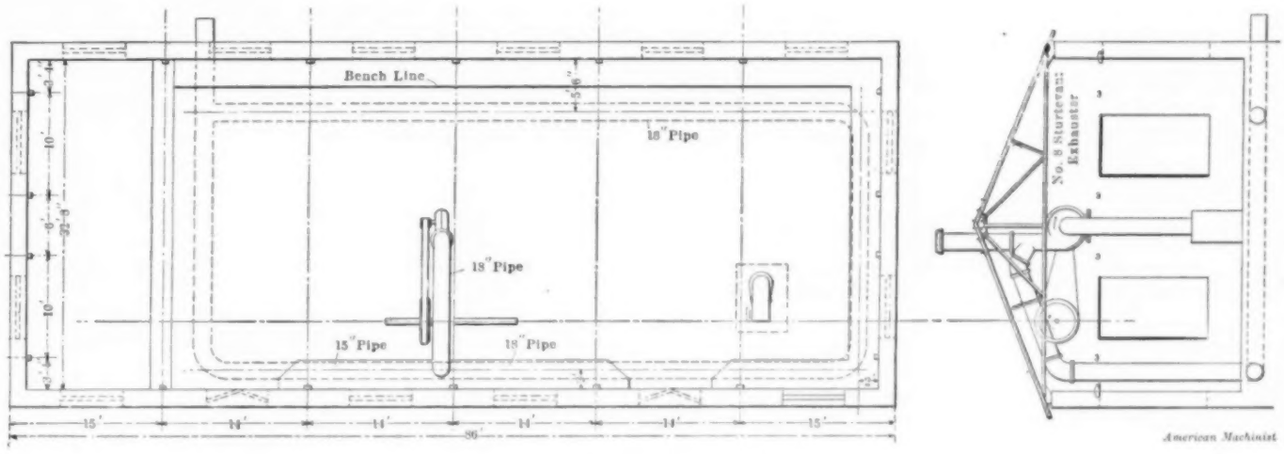


Fig. 9. Floor-heating System of the Blacksmith Shop

Hard Floors or Cold Floors—Which?

Concrete floors, in their application to machine shops, have been investigated, approved and condemned, depending upon the attitude and inclination of the person having to do with the decision as to their use or non-use. The usual objection is that the floors are hard and that the feet and ankles of the workmen are quickly tired, and if they are asked to work on a concrete floor they will surreptitiously bring in boxes or boards or something else upon which to stand rather than stand upon the concrete floor itself. Again it is asserted that standing on concrete floors tends to bring on rheumatism. The foregoing paragraphs, in regard to the heating system at once raise the question: Do workmen object to concrete floors because they are hard or because they are cold? In Mr. Morse's experience at the Trumansburg plant the men insisted on bringing in boards, boxes and the like to stand upon and even went so far as to wear heavy rubber overshoes during the working hours. That shop was heated by an indirect system. In the Ithaca plant, with the heating system beneath the floor it has been found that the men do not use boards or boxes to stand upon, neither to they try to make any special provision for keeping their feet warm by additional clothing. Their feet are at all times comfortably warm because of the heat in the floors, therefore, it is natural to conclude that the objections raised to concrete floors in the past on the score that they were hard were really raised because they were cold; the workmen did not distinguish between the uncomfortable feeling caused by the chilliness of the floor and a feeling of fatigue or tiredness which they supposed existed because the floor upon which they stood was hard. If this conclusion is true the only valid objection that has ever been urged against concrete floors for machine-shop purposes can be easily overcome.

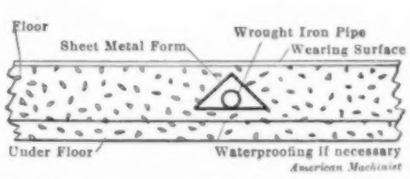


Fig. 10. Suggested Form of Duct for Floor-heating Pipe

Extensions of the System

It should be noticed that this heating system is applied to buildings one story in hight, as the pattern shop and blacksmith shop, or one story in hight with galleries, as in the main shop. Its application, therefore, to a multi-story building might need careful consideration and planning.

The simplest and cheapest installation of this kind that can be proposed is the forming of small ducts in the concrete floor by using a light sheet metal form as shown in Fig. 10 and then running through these ducts circulating pipes for an exhaust steam direct radiation system employing a vacuum pump to establish and maintain circulation. A duct of some kind is necessary to facilitate repairs.

Another engineering achievement is recorded in the completion on January 16 of the Shoshone dam in Wyoming, which is the highest structure of its kind in the world. The reservoir formed by the dam has an area of 10 square miles, and will store 148,588,500,000 gal., which is ample to supply water during the irrigating season to over 100,000 acres of exceptionally fertile land, part of which is now ready for settlers under the terms of the reclamation act.

Training of Trade School Teachers

By Entropy

The increasing attention being paid to trade education, no matter how much of it may be misdirected, is bound to produce two new things: One a crop of textbooks, the other a crop of teachers.

Now teachers and their failings are just as much of a hobby with me as the trade schools themselves; therefore, when I read the announcement of the courses offered at Columbia University it was most natural that I should ask one of my friends who has money enough to get that far from home to look up the whole matter for me. He was most favorably impressed with what he found, but he probably has not that same feeling of distrust of the professional educator that seems to envelop me.

Qualifications for Trade-school Teachers

As I understand this matter, it appears to be acknowledged on all sides that trade schools, whether public or private, shop born or school born, need teachers who know something of what they would teach. Teachers of manual training, in general, neither want these positions, nor are they considered fitted to hold them. The New York Board of Education has, in establishing vocational schools, made rules to the effect that each teacher of vocational subjects in these schools must have had five years' "successful" experience as a journeyman wage earner, together with one year's satisfactory service in teaching the same vocation. Substitutes may be appointed without having had the year of teaching. Teachers of nonvocational subjects are not required to have any practical experience, but must have had a considerable education and experience in teaching. So far as I know there is no other body that has published rules for the selection of such teachers.

In Milwaukee, Mr. Perry, I understand, has taken in shop men with no teaching experience.

In Worcester, I understand that Mr. Fish is trying to have all his men shop trained, though he has no scruples against a previous technical training provided it is previous enough. He suggests that teachers of purely cultural subjects be women of teaching experience, making the line of demarcation one of sex as well as previous experience. Most of the other schools aiming at trade training are manual-training schools that have seen a new light and are beginning to try to draw a little closer to the new movement while still clinging to the old.

The Teachers' College Course

The Columbia University, a teachers' college course, is apparently the result of the rules of the Board of Education. There being few, if any, men who fill the board's requirements who would be willing to take the starting salary, $1200 per year, in New York City, the University steps into the breach and offers evening courses calculated to qualify men already expert in the trades to teach them. The method of procedure appears to be the study of psychology, pedagogy, and of other trades having a bearing on the one of which the man is already master. That is, a machinist would take work in drawing, patternmaking, molding, forge work, etc. Subjects of general culture would also be included; English especially. No set course has as yet been adopted; a few students have been admitted and are being experimented on.

Requirements of Teaching

The scheme looks pretty good on the face, but there are some things that appear when we begin to dig into it that are a little doubtful. In the first place, there is the question of the actual requirements. In my lifetime, with about 14 years of schooling, to say nothing of some years' observation of the results of schooling on others, I have run across a number of men who succeeded in teaching beyond all the others. These few men were men of the old school, whose knowledge of psychology and pedagogy was probably negligible, but who succeeded because they knew their subjects, and because they knew their boys. Very possibly that is what constitutes psychology and pedagogy; in fact, I believe that it is, but I believe that there is understood to be something more to these two sciences than I have outlined above. There arises in my mind at this juncture the question of whether or not if a machinist *knows* his trade and understands boys, he is not already better fitted to teach the trade than he will be after any university has had a grip on him.

My meaning will be clearer if I say that school teachers have, as a class, certain undesirable habits, that it would be better for those who instruct in a trade to avoid. One of these is the habit of being overworked. I have a friend who is teaching about 20 hours a week, and he is nearly dead; that is, when he is telling the story. It is really a case of too many nerves and not enough nerve. When he goes into a class he goes in all nerved up and expecting a row. When he comes out he is as limp as a rag. He has no business being in the teaching business at all. A man to be a good lion trainer must be a man of consummate self-possession and self-confidence. A teacher ought to be made in the same mold. Instead of that, any man without enough red blood in his veins to fight his way through the world goes and isolates himself in a college, shuts himself between the covers of books and proceeds to learn to teach. As if any man who knew, really knew what he was talking about could fail to teach it if he had a chance!

To be sure if a man has run a lathe for years and then has been a foreman and shop superintendent for years more, if he starts in to tell a man how to do a job he will be likely to omit many of the minor details, because to him they are obvious. Let such a man take a class of boys and try to teach them to do that same job and he will find out in a hurry that he must go slow. He needs no pedagogy nor psychology to find that out. If he knows how to do the job so well that he can step in at any stage of the game and take the job and finish it up he will have no trouble with his class provided he has the confidence and poise necessary. If he is the sort of man who is upset at finding a cat let loose in the room or his desk turned upside down, or any little thing like that, then he will wear himself out and think he is overworked, while as a matter of fact, he is overworried.

As there are so many men in the profession, for the simple reason that they have not enough red corpuscles in their blood to do anything else except solicit life insurance, it is natural that many of them consider themselves overworked on a very small amount of actual work and a large amount of imaginary worry. The result of this is that teachers work a small number of hours as compared with the number that shops are run. The average professor's hours of duty are about 16 per week. Of course, it is supposed that he will spend at least as much more in preparing work, correcting work and keeping himself well informed on his subjects and in research work, but the man who cannot so systematize his work and put off the drudgery onto assistants is rare. The only real excuse for limited hours is the nervous strain. If there is a nervous strain they ought to look up another job. A lion trainer who loses his nerve, always changes jobs—unless the lion eats him first. If the boys murdered more professors, there would not be so many of thin-blooded variety in the profession.

Being a Professor

Another tendency among teachers is the desire to be a "professor." A professor is a member of the faculty of any institution authorized by law to grant degrees. It may appear strange to anyone that any man should care 10 cents whether he is called a professor or not,

or more than a dollar whether he really is a professor or not. There is, however, a great striving for that distinction among teachers. There is supposed to be a considerable social distinction in being on a college faculty. I never could see it. There is the lessening hours of labor, which I believe is the main factor. Teachers or nine-tenths of them are looking for more pay and less work, which two things they see going hand in hand with promotion. When a man becomes a professor, he is a professional man and as such takes no orders from anyone, theoretically. Practically he does as the body that furnishes the money suggests. To the ordinary teacher it appears that promotion to a professorship means independence, independence of authority, money and work.

What I am driving at is that I think that our trade schools, whether public or not, should be run on somewhat the lines of practical business ventures, and should come somewhere near running on the hours of commercial shops. Here in Massachusetts we have an eight-hour law which would prevent schools being run over eight hours per day, but that is different from 16 per week. The teachers ought to set the boys the example of being on duty at least as many hours as they are.

If teachers for these schools are trained by other teachers, whose ideals are those just outlined, they will inevitably have implanted the seeds of unrest, of less work and more pay, the ambition to be a professor. All of which, to my mind, will be bad for the schools. I believe that these teachers should feel at all times that the more work, the better work, the more money, just exactly as they feel it in the shops, and they should be disabused of the idea that it is worth the candle to be a professor. There is nothing in it, not even the social distinction. There is not much money in it and that little must be spent in keeping up a social show. If a man is a professor he must wear a "biled" shirt, collar and cuffs, no necktie, but a cravat; his wife may be entirely able to do all the work of the house, but she must have a girl in the kitchen and another to answer the 'phone and door bell. Neither of them can go down town without getting the things sent home, and as for setting up a stovepipe himself, why his prestige would be gone if he were caught in the act.

Unwise to Mix Professoinal Teachers and Shop Men

It will also be found true, I believe, that mingling of professional teachers and shop men in a school will tend to produce unrest. It is not hard to labor through the day and see other people ride by in automobiles, but if the man with the auto picks you up and gives you a ride too often you are sure to come to envy him in the end. The next step is to want the leisure and the next the automobile. Put two men into the same school, one drawing teacher's salary and 16 hours per week, the other journeyman's or foreman's wages and 48 hours, and the inevitable will happen, with a final result of two entirely dissatisfied men, and a school with an expense account that will loom up large. Therefore, I believe that it will prove good policy to cut out the professional teacher, even to the extent of having mathematics, physics, etc., taught by shop men.

I can imagine some professor of physics muttering something about "crazy men" just here but my belief is that about all the physics a shop man needs is what a shop man uses. Some shop men use more than others and all use more than they realize. A man needs to know how heat is transmitted, and how hard it is to account for it all; how light is transmitted and how a lens acts on it; how sound is carried and how stopped; how electricity is generated and so on—all of which are common shop necessities at some time or other. He does not need to know how to measure the length of a light wave, nor the difference between A sharp and B flat, nor all about the temperature—entropy diagram, nor the differential equations of a sine curve. A teacher, ordinary garden variety of teacher, could not tell which he ought to have. I will confess that there are few shop men who could teach this subject as it ought to be taught even after thoroughly working it up, but I would rather have them work it up without the aid of a university graduate.

A Plea for Higher Salaries for Teachers

Now I hope no one will read into this article any desire to overwork the teaching profession. On the contrary I would like to see teachers relieved of the necessity of working so hard outside of school to keep body and soul together that they are unfitted to give their best efforts to their legitimate work. The most natural work for a teacher to turn to is tutoring backward pupils. It is also the hardest possible kind of work, and does more to sap one's vitality than anything else, yet men who "teach" only 16 hours per week on a salary tutor as many hours a week for from 50 cents to $2 an hour as they can get pupils. A total of 40 hours per week in addition to time spent in preparation and connection is nothing so unusual as to demand comment. Teachers in day classes who would resent being required to teach more than 20 hours per week will go to other schools and teach 3 hours per night and spend two hours on the road to and from to do it. I picked up just such a case in Boston the other day.

What I believe is possible is to pay men living salaries and have them do a reasonable amount of work. We will not get to that point while teachers can examine and mark their own pupils, nor while less work and more pay is the program of advancement. In no other trade or profession does the man who does the work also act as judge of that work. If I build lathes, I may inspect my own work before it is sent out, but the final word, that tells whether the machines stay sold or not, comes from my customers. In college the final word as to whether the student graduates comes from the men who have molded him for four years. What the business world, that hires these graduates, has to say has no effect on these teachers. The business world cannot say. "Take this young man back and run him through the mill again." Oh! no, they have to assimilate him the best they can. Possibly this may account for some of the unrest prevailing among employers of college graduates.

Soft Soldering a Gear to a Spindle

By C. St. John

While soft soldering is not considered a very mechanical way of fastening machine parts it sometimes helps one out of a difficulty in a surprising manner. Over a year ago I had the job of repairing a lathe on which the main driving gear was very loose on the spindle. The spindle was hollow and so thin that it did not furnish a good support for the key. The gear, spindle, keyseat and key were cleaned and carefully tinned. They were then heated hot enough to melt the solder and assembled. The lathe has been in hard service ever since and the gear is still perfectly tight.

I have used this method on other gears and have never had one work loose, although they can be quickly removed at any time with the aid of a blow torch.

The use of nickel wire for electric furnaces is not preferred to platinum, because, although much cheaper, the nickel becomes brittle when exposed to high temperature. Prof. H. C. H. Carpenter found this brittleness to be partly due to the gradual escape of the occluded gases. Prof. M. Le Blanc, of Leipzig, on the other hand, found nickel wire suitable in experiments in which the furnaces were heated to 1300 degrees Centigrade and Nernst mentioned during the discussion of a paper read by M. Le Blanc in the Deutsche Bunsen Gesellschaft, that he wound his nickel wire on a copper tube (instead of clay or porcelain), and insulated the copper with asbestos and sodium silicate; the wire itself was finally coated with a mixture of sodium silicate and soapstone.—*Engineering.*

An Angle Plate and an Improvised Boring Mill

A very convenient angle plate, as shown in Fig. 1, was recently found in the shop of the Smart & Turner Manufacturing Company, Hamilton, Ontario, Canada. The principal dimensions are given, which are the result of considerable experimenting to find the best provided for locating the plates, either parallel or at right angles, or for any special angle that may be needed in any class of work.

Figs. 2 and 3 show two of the uses to which it is put in planing crossheads. The plates are simply used to secure the sides being machined are to be parallel, the plates are first set at 90 degrees, and after one side is planed they are swung into an opposite position, as indicated by the arrow, so that the other side will be parallel with the first. The work is also blocked up in this case.

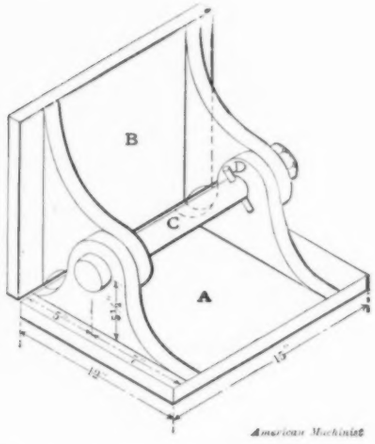
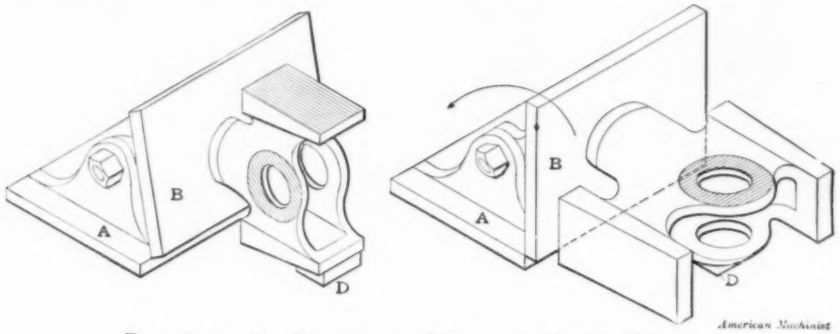


FIG. 1. A CONVENIENT ANGLE PLATE



FIGS. 2 AND 3. METHODS OF USING THE ANGLE PLATE

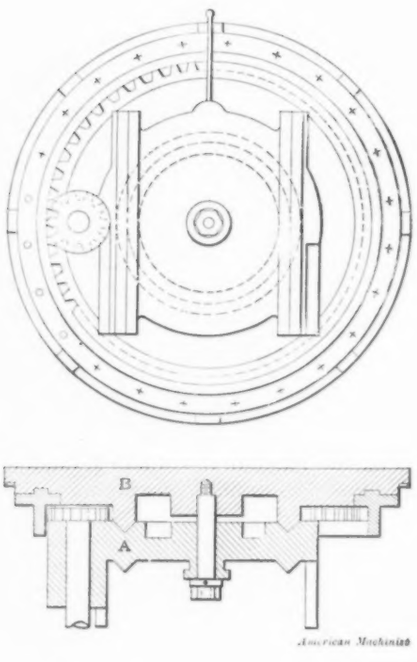


FIG. 5. DETAILS OF THE TABLE

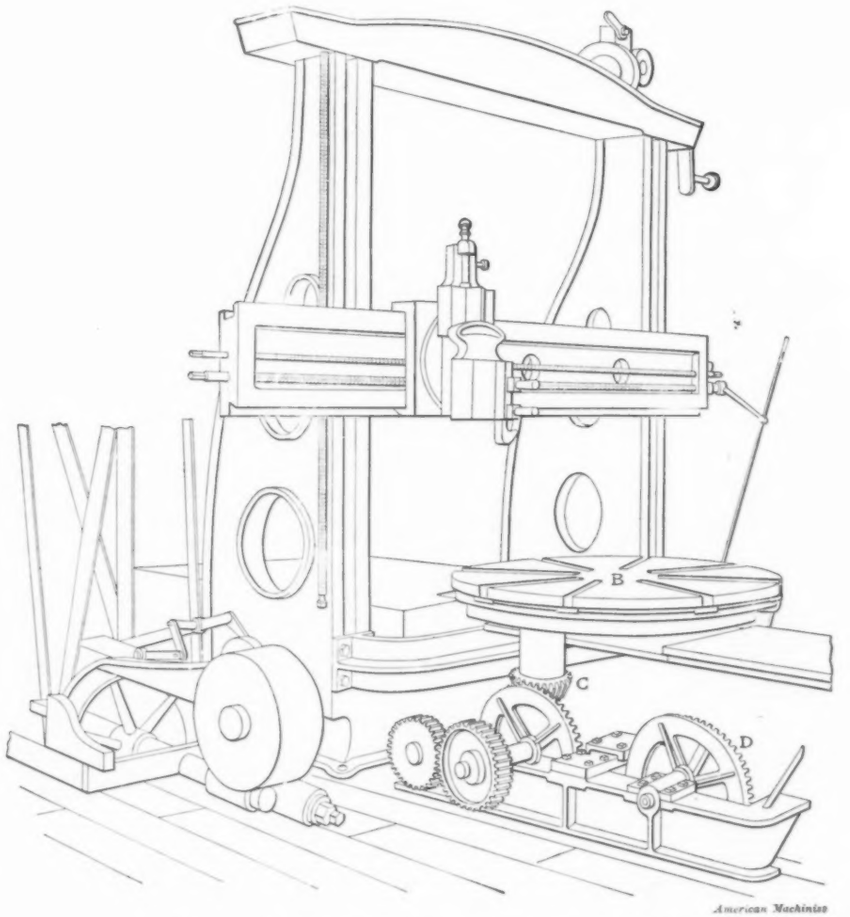


FIG. 4. PLANER WITH BORING MILL ATTACHMENT

portions for general work. As can be seen, it is very essential that the two plates be firmly locked in any desired position, and to accomplish this the nut at the further end of the bolt draws the pin *P* against the inside ear of the plate *A*. Index pins can also be readily provided for locating the plates, either parallel or at right angles, or for any special angle that may be needed in any class of work.

Figs. 2 and 3 show two of the uses to which it is put in planing crossheads. The plates are simply used to secure the sides being machined are to be parallel, the plates are first set at 90 degrees, and after one side is planed they are swung into an opposite position, as indicated by the arrow, so that the other side will be parallel with the first. The work is also blocked up in this case.

AN IMPROVISED BORING MILL

In this same shop was a very interesting fixture which has been devised to handle some good-sized mill work, no boring mill being available for this purpose. So the saddle *A*, Fig. 5, was made to fit the ways of the planer and on it

was mounted a rotary table *B* with geared teeth inside the edge so as to be driven in the manner indicated at the side. An extension was put on the bull-wheel shaft to carry the bevel gear, shown at *C*, which drives the table through the bevel and spur pinions shown. These are substantially supported, as can be seen in Fig. 4.

The saddle *A* is held in position by a bracket on each side. In order to increase the capacity, an extra shaft, also carrying a bevel gear, has been mounted at *D* and is driven by spur gears from *C*. In this way a very substantial boring mill is secured when desired, and one of the planer heads on the cross-rail has been fitted up for boring, so that fairly large pulleys can be bored and turned at the same time. This device reduced the machining time on a large piece of work from 80 to 18 hours, the work formerly being done on a 60-inch lathe and produced very satisfactory results.

This, as well as the angle plates shown, were devised by superintendent R. McKechnie, of these shops.

Compressed Air for Pneumatic Hammers

It is to be regretted that through a mistaken policy in the beginning, many of the manufacturers of pneumatic tools have heretofore resorted to the publication of what are really "nominal ratings" for the cubic feet of air required to drive their machines. This condition of affairs is similar to that in the automobile business, where a tendency to overrate the engine power in many cases is well known. The excuse for such procedure is that the other fellow does it, and consequently if any manufacturer has the backbone to give the real figures, his machines will not compare so favorably on paper with those of his competitor.

Some measure of excuse may be granted when it is said that most of the figures given for air required to drive pneumatic tools are based upon calculation and estimation only, as the actual measurement of the air required to drive any machine is a little difficult to accomplish without special apparatus. As a matter of fact pneumatic tools of different makes do not vary a great deal in their air consumption for a given amount of work done, and so, for estimation purposes for the installation of a suitable compressor, the figures given in the accompanying table are of timely interest.

In this table are given the actual cubic feet of free air required per minute and the power to operate from one to fifty pneumatic hammers of the cylinder diameters and strokes shown. The quantities of free air for one tool have been obtained by careful experimenters with special water-displacement apparatus and being the averages of a great many readings, may be taken as accurate and fairly representative for most tools of similar dimensions. The figures for more than one tool were obtained by deducting 2 per cent. for every five tools; that is, five chipping hammers are assumed to require 4.8 times as much air as one chipping hammer of equal size. Ten hammers are assumed to require 9.6 times as much as one hammer, and so on. This is to allow for the intermittent action of different tools in a shop, and this basis of calculation agrees very nicely with observed shop practice.

The quantities of air, as shown by the larger figures in the table, are actual cubic feet of free air required at atmospheric pressure at sea level, this air being delivered to the tool at 80 pounds pressure. The figures for horsepower, which are the smaller figures in the table, assume compound compression to 85 pounds pressure; that is, allowing 5 pounds drop in the pipe line. The figures for power also include reasonable friction of the compressor and the usual losses of power in the air cylinder of an air compressor of reasonably good design. They would represent just about the brake horsepower required from an electric motor to drive a compressor actually delivering the quantity of air given by the large figures above them.

This brings up the point of the volumetric efficiency of the compressor. As the quantities shown were obtained by actual measurement of air used, it is imperative that the output of the compressor shall be equal to this. To allow for volumetric efficiency loss, this necessitates that the piston displacement of the compressor shall be greater than these figures by from 8 to 12 per cent., depending upon its design. The figures for power required include this loss, as they represent the power necessary to actually deliver the quantities of air shown as the actual output of the compressor.

In cases where single-stage compression is used the power required may be obtained by adding about 15 per cent. to the power figures given. This, of course, has no effect upon the air quantity.

It has been stated that these figures are for sea-level operation. This will be satisfactory for most localities, but at 5000 feet elevation 17 per cent. more free air capacity will be required and about 7 per cent. more horsepower, for the same size and number of tools. These increases are practically proportional to the altitude. S. B. R.

Number of tools.....		1	5	10	15	20	25	30	35	40	45	50
Chipping Hammers.	Diameter Stroke.											
	1¼"x1"	14 2.6	69 13	134 25	197 37	258 48	315 59	370 69	421 79	470 88	517 96	560 104
	1¼"x2"	17 3.2	18 16	163 30	240 45	313 58	383 71	449 84	512 95	571 106	627 117	680 127
	1¼"x3"	20 3.7	98 18	192 36	282 52	368 69	450 84	528 98	602 112	672 125	738 137	800 149
	1¼"x4"	22 4.1	108 20	211 39	310 58	405 75	495 92	581 108	662 123	739 138	812 151	880 164
	1¼"x5"	25 4.7	123 23	240 45	353 66	460 86	560 105	660 123	753 140	840 156	923 172	1000 186
Riveters.	1⅝"x6"	33 6.1	162 30	317 59	465 87	607 113	743 138	875 162	993 185	1109 206	1218 227	1320 246
	1⅝"x8"	36 6.7	176 33	346 64	508 95	662 123	810 151	950 177	1084 202	1210 225	1328 247	1440 268
	1⅝"x9"	38 7.1	186 35	365 68	536 100	699 130	855 159	1003 187	1144 213	1277 238	1402 261	1520 283

Large figures are free air and small figures are horsepower to drive compressor. Figures for air are for 80 pounds pressure at sea level, and are based on ordinary intermittent service as is usual in any shop. Ratings for one hammer are actual readings from water displacement tests, being averages of many trials. Horsepower figures assume compound air compression to 85 pounds pressure and include friction. For single stage compression to 85 pounds add 15 per cent to power figures. Compressor displacement required should include volumetric loss as figures are for actual air delivered.

TABLE OF ACTUAL CUBIC FEET OF FREE AIR REQUIRED PER MINUTE AND POWER TO OPERATE FROM 1 TO 50 PNEUMATIC HAMMERS OF THE SIZES SHOWN.

A white brazing solder which may be used with good results, according to the *Brass World*, on iron and steel consists of copper 45 per cent., zinc 45 per cent. and nickel 10 per cent. The use of the small quantity of nickel in the mixture gives the necessary whiteness and increases the melting point but slightly. In brazing steel or iron silver solder, which flows readily without oxide, and at a low temperature, is very preferable, but its expensiveness sometimes makes a suitable substitute desirable.

MAKING AUTOMATIC TURRET CHUCKS

Interesting Special Tools Used in Constructing Automatic Machine Parts

BY F. A. STANLEY

In a recent article a description was given of some of the methods and devices employed by George G. Prentice & Co., Inc., New Haven, Conn., in connection with the machining and testing of the beds, heads and spindles of their automatic turret machines. It is the purpose of the present article to illustrate some further processes and tools adopted by this company for making chucks, faceplates, index wheels and certain other important members not dealt with specifically in the article referred to above.

In Fig. 1 an illustration is presented giving some idea of the different styles of chucks and faceplates made for the Prentice automatics; the chucks shown being adapted for three-, four- and five-spindle, single-head machines, and six- and eight-spindle double-head machines. At the left in the group will be seen a faceplate for holding five pieces of work. At the front of this is a detached index wheel and star wheel, while in the middle and background are four turret barrels with their chucks, index and "star" wheels assembled in place.

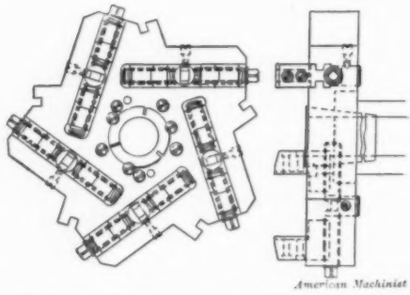


FIG. 2. SECTIONAL BOX CHUCK FOR PRENTICE AUTOMATIC TURRET MACHINE

MAKING WORK CHUCKS

The chucks for the single-head machine are first bored and faced in the chucking machine, then placed on an index fixture on the milling machine, where the outside surfaces are rough milled. The general shape of the chuck is represented in Fig. 2, and as there shown it is provided with indexing surfaces, which in operation rest upon an abutment at the front of the machine to support the chuck, and in its face is formed a series of tangential slots to receive the jaws which are operated by right- and left-hand screws. The slots for these jaws are first rough planed; the indexing surfaces referred to are finished on the miller, then by using these surfaces to index the chuck upon the milling machine the slots for the jaws are finished by running in a roughing and then a finishing mill which cuts the slots out to size.

The method of milling the outside of the chucks is clearly illustrated in Fig. 3, where the work is shown mounted upon a central post in an indexing fixture on a Garvin miller; the fixture consisting of a supporting drum with an index ring at the bottom and a sliding lock bolt adapted to engage the notches in the ring. A

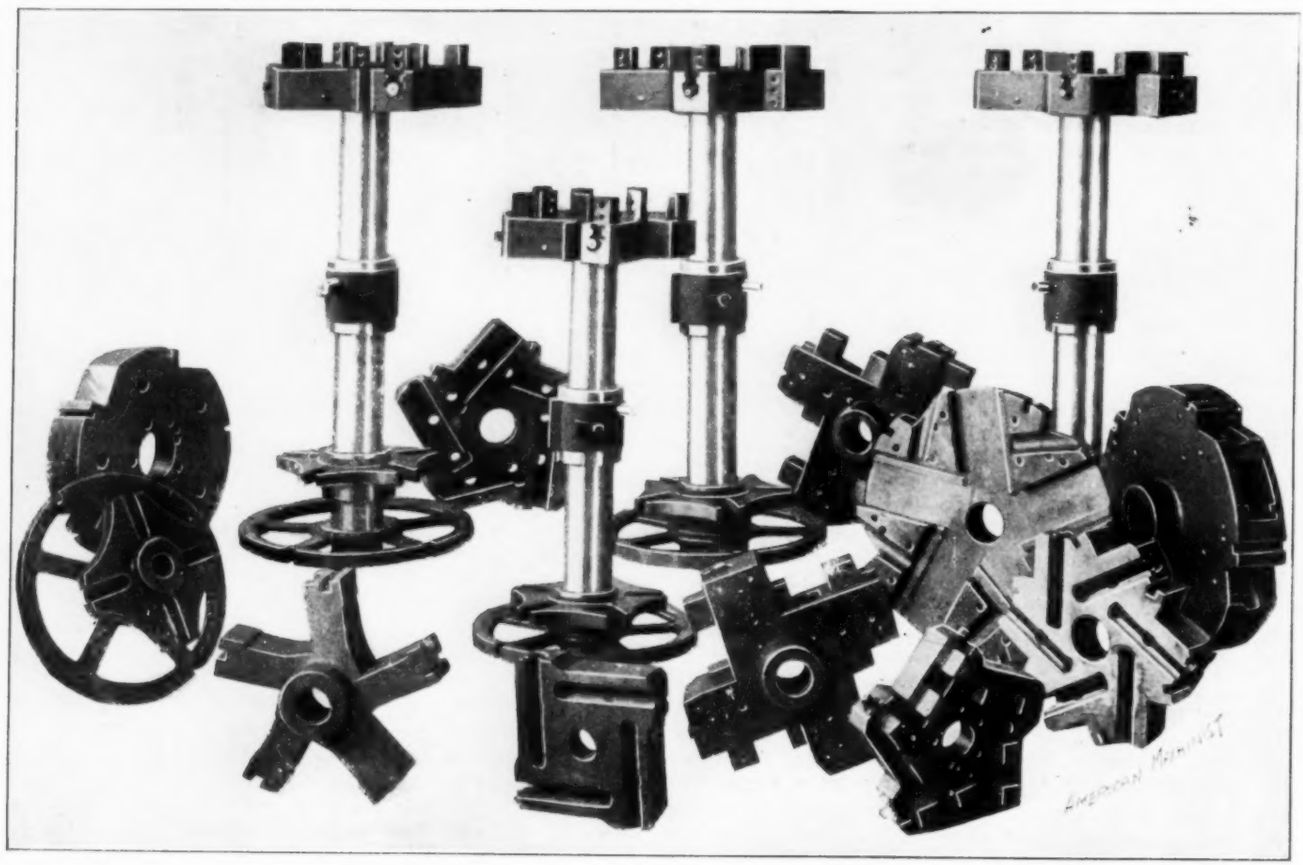


FIG. 1. GROUP OF TURRET BARRELS, INDEX WHEELS, SECTIONAL CHUCKS AND FACE PLATES FOR PRENTICE AUTOMATIC TURRET MACHINES

large inserted-tooth cutter is employed in milling the outside of the chuck to shape and with the table properly adjusted for the series of cuts around the periphery of the work the latter is fed vertically to the mill. After each cut has been taken vertically down the face, the holding straps are loosened and the work indexed for the next cut.

A Reaming Fixture

The chuck-jaw screws are prevented from moving endwise when in place by a circumferential channel near the middle of their length which is engaged by a forked end on a plug inserted from the back of the chuck body. The screw itself rests in a seat machined out in the chuck body parallel to the chuck-jaw slot. An interesting tool for finishing this seat is illustrated in Fig. 4. This device, while

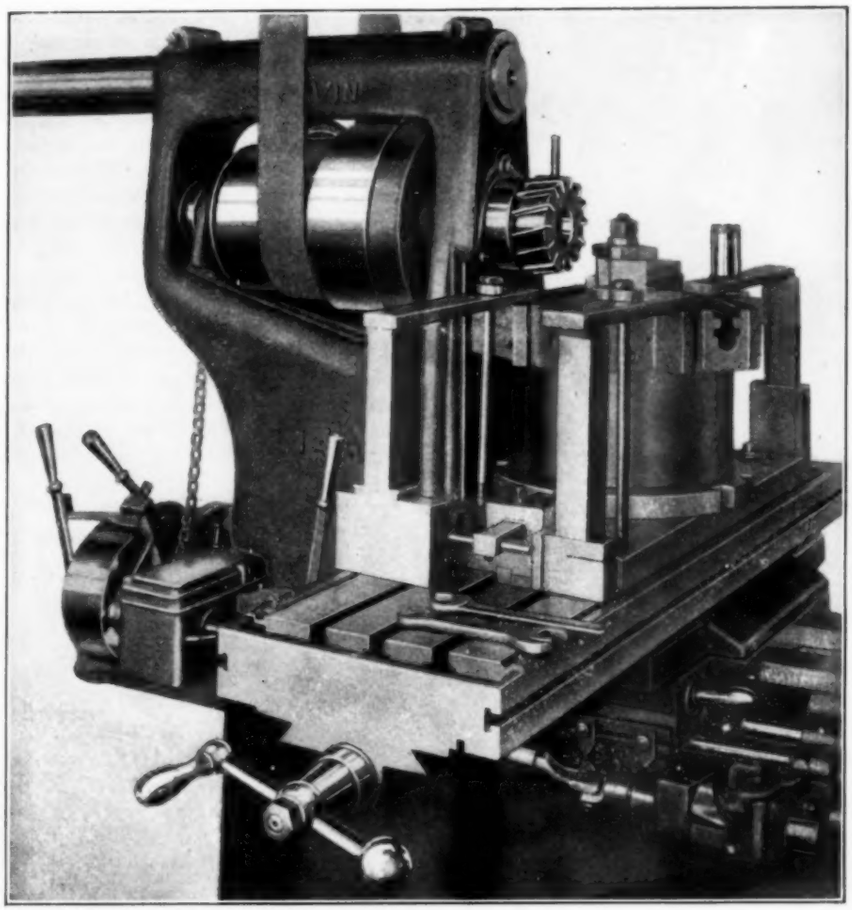


Fig. 3. Index Milling the Outside of the Chuck Body

known as a reaming fixture, will be considered by some a milling tool, as it makes use of a small mill mounted upon a spindle which is journaled in a block sliding in the chuck-jaw slot. The block is, in section, a duplicate of the chuck jaw itself. The operation is performed under a drill press. The end of the spindle carrying the cutter is carried in the chuck in the drill spindle and the whole device fed down into the work while the guide block supports the lower end of the cutter spindle and insures a smooth surface. The cutter which acts as a reamer is, of course, kept to the exact size required for forming a proper bearing for the screw.

How the Chuck Is Attached to the Turret Barrel

The various holes in the chuck face are drilled with a plate jig. Then the jaws are fitted in place along with the screws by which they are operated.

The chuck body is attached to the end of the turret barrel in the manner represented by the drawing, Fig. 2. In this construction the chuck body is bored out for a distance from the back leaving a shoulder which abuts against a corresponding shoulder near the front end of the turret barrel. The latter with the chuck in place is placed in the lathe and a taper hole is bored from the front of the chuck back into the mouth of the barrel, as illustrated, forming an unbroken taper surface into which a split taper sleeve of cast iron is drawn by the screws shown at the front. This construction provides a rigid connection between chuck and turret barrel and at the same time admits of sufficient adjustment to compensate for any wear likely to take place between the spindle which passes through the barrel and the bearing surface at the mouth of the barrel.

Chuck-jaw Operations

The chuck jaws after they are fitted in the slots, and after the turret barrel and chuck are mounted in place in the turret machine, are opened by their screws opposite one of the tool spindles, and with the tool in place the jaws are marked by rotating the spindle, thus securing a working point from which their faces may be machined equidistant from the spindle center. They are faced off accurately

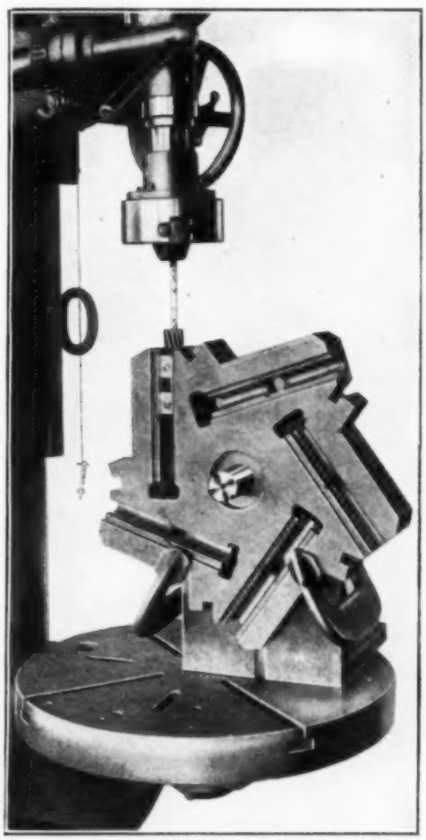


Fig. 4. Reaming the Seats for the Chuck-jaw Screws

to this line, and the grooves for the tongues of the false jaws, which are shaped to suit the kind of work which has to be machined in the chuck, are milled at the same time that the jaws are faced off. In preparing the surfaces of these jaws, upon which various forms of false jaws may be attached, very little leeway is given the workman, as it is considered important that they shall close centrally, and when opened to any point, be practically at equal distances from the spindle center.

Operations on a Star Wheel

The cast-iron member, Fig. 5, which performs the function of indexing the turret from the rear end, acts upon the Geneva stop principle and is commonly called a star wheel. Some interesting processes are involved in the finishing of this member, one of which is illustrated in Fig. 6. In the first place the casting is

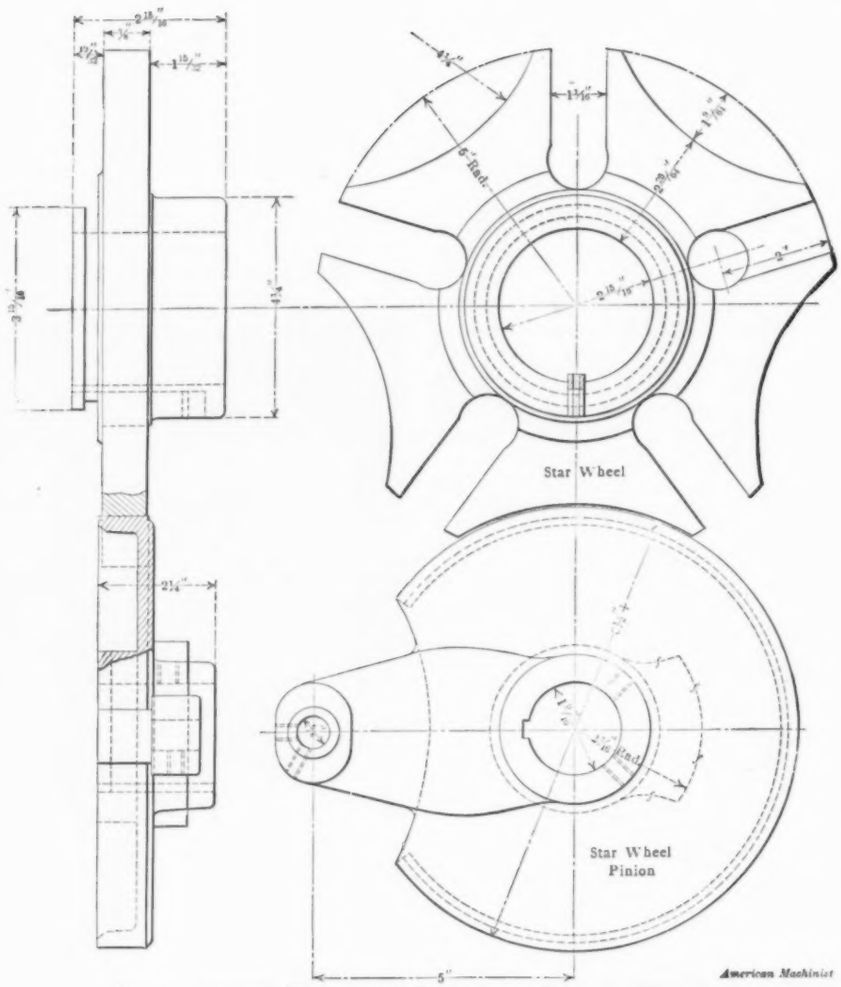


FIG. 5. "STAR" WHEEL AND DRIVER FOR INDEXING TURRET

bored and faced; the radial slots which receive the roll on the driving member by which the star wheel is intermittently indexed, are then rough milled. At the inner end of each slot there is an enlarged opening, which is finished by counterboring in the third operation. Following this the star wheel is mounted upon a vertical stud or post in the fixture in the drill press, shown in Fig. 6, where the concave surfaces in the rims for the driver are swept out by a fly cutter carried in the drill spindle. In this operation sufficient metal is left for finishing later on. The bore is now ground accurately to size and the five radial slots are finished to exact width in the milling machine. The final machining operation, the seventh in the series here recorded, is accomplished in the same fixture as the fourth, and consists in finish-sweeping the curved surfaces in the edge of the wheel.

The method of supporting the lower end of the bar upon which the fly-cutter head is mounted will be obvious upon inspection of the halftone. As will be noticed, there are two guide bushings in the fixture located at different distances from the centering post upon which the work is mounted, the fixture thus being adapted for handling two sizes of wheels. For indexing the work for the successive cuts a stop is provided which enters the radial slot and against which the work is pressed by means of a set screw in the post shown at the front of the fixture; this not only locates the work correctly, but also holds it steady during the sweeping operation.

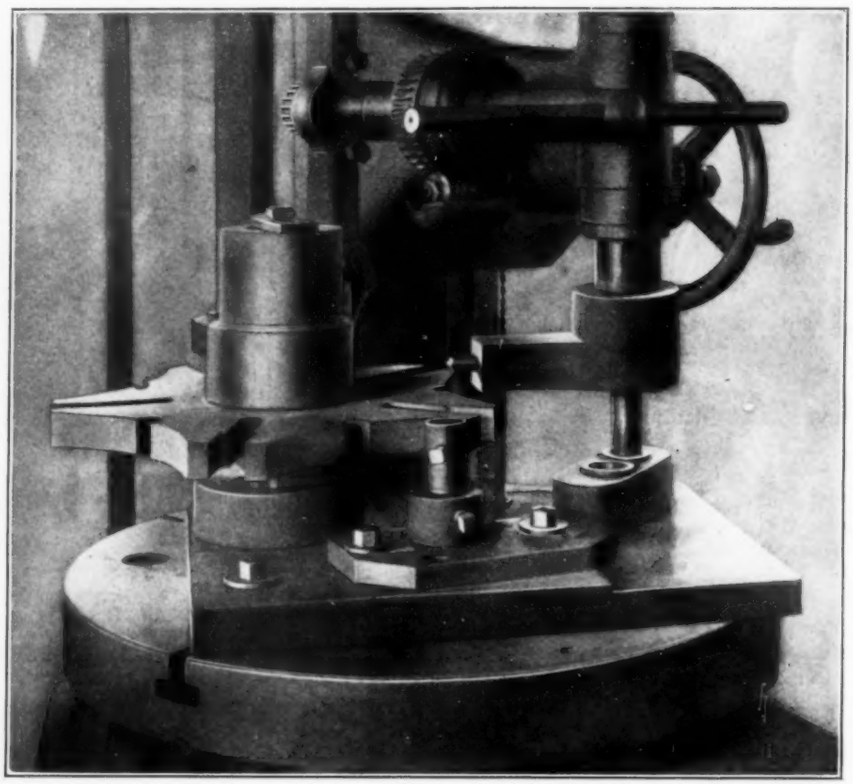


FIG. 6. SWEEPING OUT THE EDGES OF A "STAR" WHEEL

INDEX WHEELS

For cutting the five notches in the index wheel a master wheel is used on a fixture attached to the milling machine, and care is taken to see that the work is not distorted by too heavy cuts or coarse feeds. The notches in this wheel have one straight side and one sloping face, as indicated in Fig. 7, the sloping face having an angle of 15 degrees and the index rocker bearing in such a way in the notch as to place the wear upon this surface.

The arrangement illustrated in Fig. 8 is used in testing the accuracy of the spacing of these notches. A plug on the table is adapted to fit the nicely finished bore of the index wheel and two adjustable blocks narrower at the end than the notches are slipped into place in adjacent notches, and with their working faces in contact with the straight side of the notches are clamped to the plate. The wheel is then lifted above these blocks, turned one space to right or left and lowered again over the blocks. Tissue-paper feelers are used between the blocks and the straight walls of the notches to reveal the nature of the contact between the wheel and the test blocks,

and if any inaccuracy in the spacing is discovered scraping is resorted to as a corrective measure. Naturally considerable patience is required to execute this test properly, and if an error in the milling comes to light, some little time must be devoted to correcting the inaccuracy

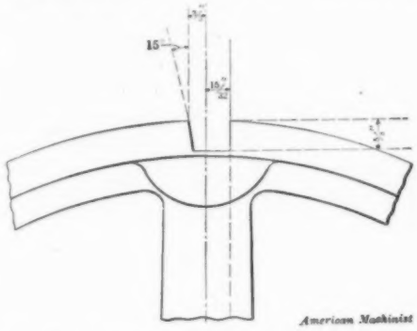


FIG. 7. SECTION OF RIM OF INDEX WHEEL SHOWING SHAPE OF NOTCH

and testing the wheel over the series of five notches.

OPERATIONS ON CHUCKS FOR DOUBLE-HEAD MACHINES

While most of the illustrations presented in this article and in the preceding one on the Prentice methods pertain especially to means of handling the single-head automatic, the methods described are also followed very closely in the construction of the double-head machine,

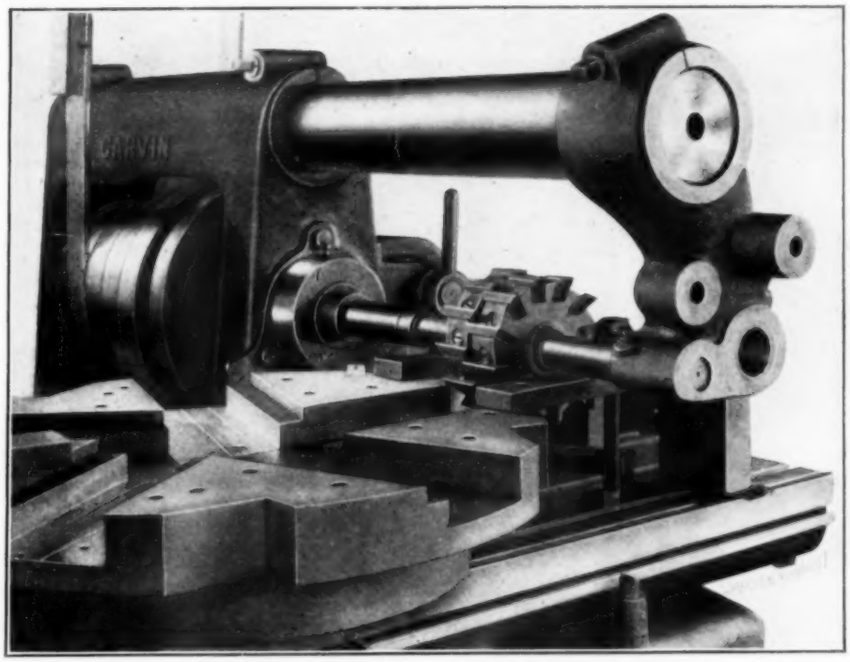


FIG. 9. MILLING JAW SLOTS IN DOUBLE CHUCK

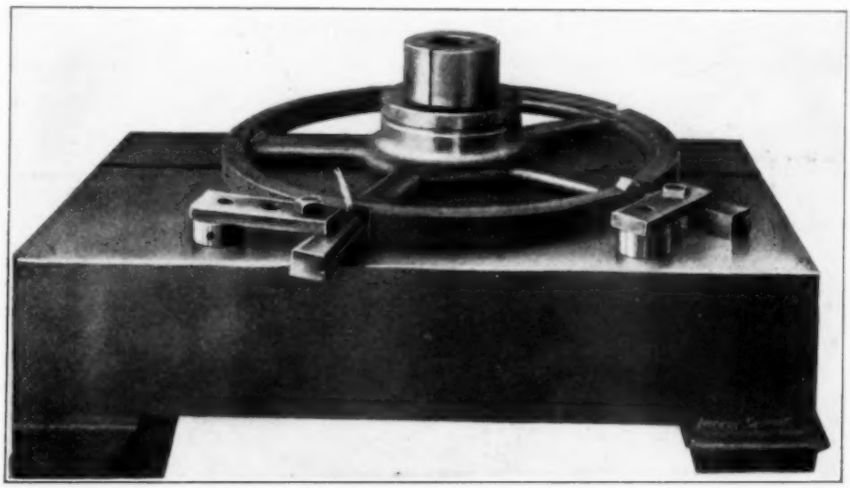


FIG. 8. TESTING AN INDEX WHEEL

which has spindles at either side of the chuck and, therefore, can machine both ends of a piece of work at the same time.

A chuck for one of these double-head machines will be seen at the right in the group, Fig. 1, and as there shown, it is made in halves to facilitate machining. One of the halves is shown just to the left of the complete chuck with its inner face exposed, giving a pretty good idea of the arrangement of the internal slots. In Fig. 9 a slot-milling operation upon one of these chuck members is illustrated. Two cutters of the inserted-tooth type are carried on the arbor and these mill the slots to the required width in the inner face of the chuck disk. Before this operation is started, however, the outside of the chuck has been milled, giving locating points for setting up for the slot-milling operation.

MILLING EDGES AND SLOTS IN CHUCKS

In the first place the two castings for the chuck are bored, faced and turned, then they are jig drilled and put together with screws and dowels. Then, on the same fixture as is used for milling the outside of the single-head chuck, Fig. 3, the two parts of the double chuck are index milled around the outside, after which the chuck is taken apart and the slots cut in the inner face of each half, as shown in Fig. 9. In locating the work on the miller table, two angle irons are used, one of which will be seen at *A*, these being set against two opposite indexing surfaces on the periphery of the chuck. The positions of the slots required in the work are first scribed on the face in accordance with the drawing, and these lines used as setting points for the work. After one slot has been milled the straps are removed from the chuck plate, the latter is lifted away from the index blocks, turned on the centering plug to the next position and reclamped in contact with the blocks ready for the milling of the next slot, the process being repeated until the series of cuts have been taken. The other half of the chuck is then slipped in place on the miller table and indexed from the same points as the first half, so that when reassembled the interior of the chuck plates will match up as correctly as the outside surfaces.

TESTING WITH DOUBLE-HEAD CHUCKS

In connection with this account of some of the operations on these double chucks reference may be made briefly to the testing of double-head machines. In general the procedure is quite similar to that followed on the single-head machines, and described in the previous article on the Prentice shops, but in testing the alinement of spindles and the indexing of the chucks, two test plugs are located or turned up in opposite faces of the chuck with the corresponding spindles, and when the chuck is indexed around and the indicator applied as described in con-

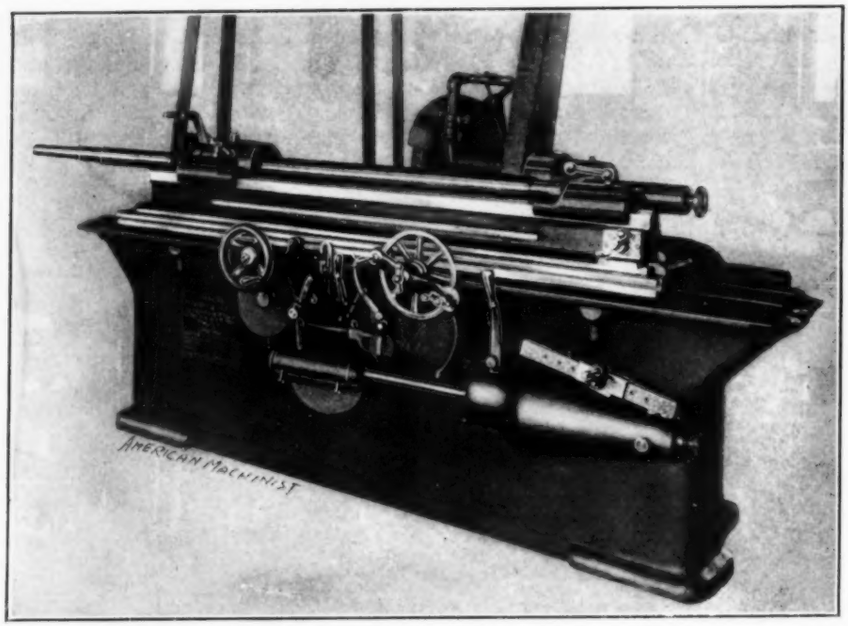


FIG. 10. GRINDING A LONG SHAFT

nection with the single-head machines, the spindles at both sides are tested readily and any lack of alinement easily discovered.

GRINDING LONG WORK IN A SHORT MACHINE

On the larger sizes of the Prentice turret machines there are certain shafts which are considerably longer than any of the grinding machines in the works will swing between centers, some of these shafts which have to be ground their entire length ranging up to 12 or 15 feet in length. Fig. 10 shows how work of this kind too long to swing between centers is ground satisfactorily. The machine in the illustration is a Norton 10x50-inch, and the shaft length is over three times the maximum rated capacity of the grinder. In handling this work a special head is used consisting of a long sleeve or collet in which the shaft is held and rotated in the head, the inner end of the shaft being carried in the customary manner upon a dead center in the tailstock. Three adjusting screws for the chuck which holds the work are set up while the work is indicated until the test indicator shows the shaft to run true. After grinding that portion projecting to the right of the driving head, the piece is turned end for end, the opposite end placed on the tail center and the indicator then applied to the portion previously ground while the shaft is being secured in the head for the finishing of the second end.

By using care in the preliminary setting, accurate results are regularly obtained in finishing shafts by this method. In the cases of very long shafts which would project, say, more than half their length through the special head, a second head of the same type is placed on the grinder in place of the tailstock and the work is then passed through the two heads. In three settings both ends and center are ground by using the hollow headstock and hollow footstock.

Two Methods of Jointing Piston Rings.

The jointing of piston rings is a comparatively simple operation and yet there are many different ways of doing it. Fig. 1 shows the method used by the Pierce Arrow Motor Car Company in which the cut is made at an angle of 45 degrees by two saws mounted on the arbor of a hand milling machine whose head is locked in its correct hight for this work.

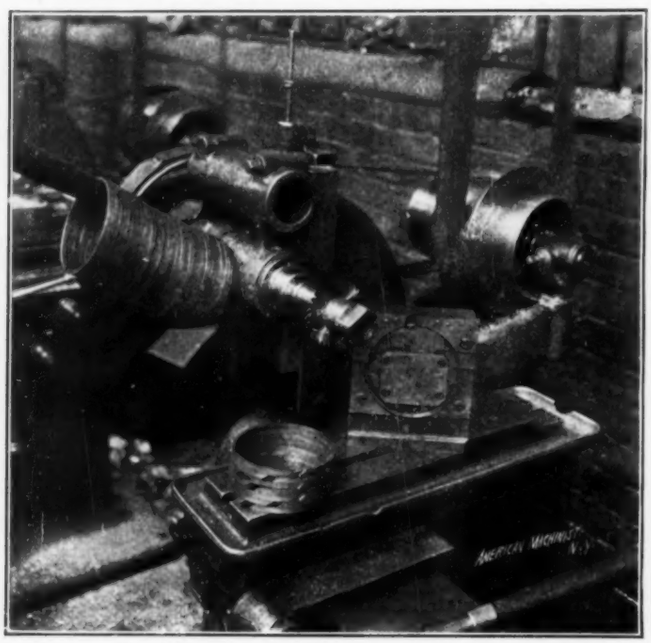


FIG. 1. THE PIERCE METHOD OF CUTTING PISTON RINGS

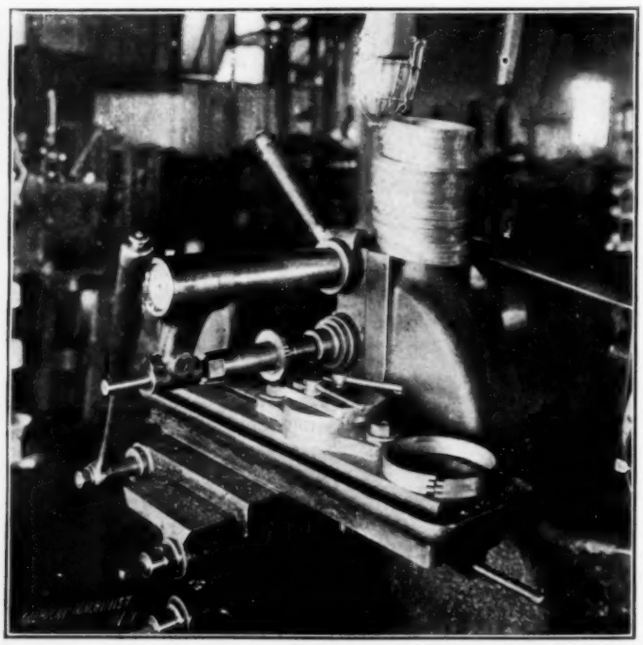


FIG. 2. PLAN USED BY THE BUFFALO GASOLENE ENGINE COMPANY

The fixture is an angle plate set to bring the break in the rings at the desired position and holding the rings up in place by a movable jaw in the center. The jaw drops sufficiently to allow the rings to be slipped over it and then carries them up into position behind the projecting lips of the upper jaws. This holds them very securely both during and after cutting and also allows them to be taken off and replaced very easily and quickly. The rings are set to a mark on the thin side which is made at the time the rings are turned.

In Fig. 2 the rings are lap jointed, this being accomplished by the milling cutter shown, which is the width of the lap. The rings are quickly clamped in the holding vise shown, each ring being set by a mark at one side of the milling cutter brought to this mark.

After the rings are cut on one side they are turned over so that the mark comes in the same position and when the second cut has been made half way through it cuts the rings into two parts, leaving a tongue on each end and completing the lap joint.

In both instances it will be seen that the hand milling machine is used, showing that there are many kinds of work which can best be done in this way.

There is considerable difference of opinion in regard to the amount to be allowed between the rings and the grooves in the piston. If it were not for the noise this would not be important as an allowance of 0.005 or even 0.010 would not materially affect the compression or the wear. But it only requires a very small movement to produce a decidedly disagreeable click which is particularly objectionable in automobile work. On this account the allowance has been cut down in most cases to very small proportions, and an allowance of 0.00025 is not infrequently the maximum allowed in this work.

Safety of Aeroplane Truss Wires

By Con Wise

There was a time when the bicycle business was on the increase, when the mania for reduction in weight was more than prevalent. Machines were built which weighed only 16 or 18 pounds. A strong, substantial machine could be built weighing 30 pounds. The light machines went to pieces very easily. In fact if a 200-pound man wanted to ride a 30-pound machine and get all the effect of having a 20-pound machine, all he had to do was to train off 10 pounds of his own weight.

What suggested the above was a chance which I had a few days ago to look over one of the successful aëroplanes. The machine as framed up looks something like Fig. 1 for a front view. Practically all the weight of operator and engine comes in the middle panel; all the outer ones do is to hold the middle ones up. The distribution of loading is about as shown. Of course, half of the actual uplift of the air comes on the top chords, but for our purposes it makes no difference whether it is distributed or not. There is on this machine another similar truss at the back of the planes, but it did not seem likely that it was any great help, both operator and engine being well forward.

If the weight coming on the front truss is called W, then the stress in tie rod or wire C will be $\frac{1}{8}W \div 0.707$, C being on an angle of 45 degrees. If W is 300 pounds, which is reasonable, then the stress in C will be 160 pounds. If 12,000 pounds is taken as a safe stress, which is high considering the liability to sudden stresses and the unmechanical fastening of the ties, the wires should be 0.13 inch diameter, or a trifle over $\frac{1}{8}$ inch. These wires were really only about 0.05 inch diameter, or less than one-half what they should be.

The wires in the outer panel at D were of the same size, but they only have to carry one-third the stress that wires C carry. Considering that these wires are all put under an initial stress that is nearly up to their safe strength, as one could judge by "twanging" them, I do not believe that the machine can be considered really safe.

There were in all about 30 feet of wires C and the same of wires D, counting those in the rear truss, which I do not believe need strengthening. It would have taken less than 2 pounds more steel in these ties to have made them safe if 12,000 pounds per square inch is safe! Think of it! Two pounds more steel to be safe,

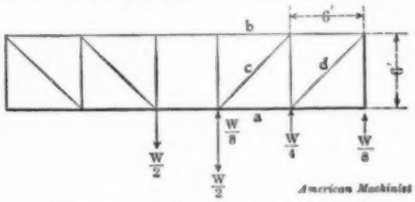


DIAGRAM OF AEROPLANE TRUSSING

and the man in charge could have gone out and got a hair cut and thrown away his bunch of keys and saved the two pounds on his own weight.

Looking this machine and its record all over and reading the excellent descriptions of other machines that have appeared from time to time in your journal, it seems likely that aëroplanes are not necessarily a dangerous kind of craft. The death rate is really very low. If they can only be designed instead of just built, they will be safer yet. If the power gives out and the operator keeps his head he can, if he is up a hundred feet or so, pick out a lighting place having quite a radius of action even then by gliding as far as possible. It does seem to me though that if I was going to trust my life to one of these machines with the limited amount of life insurance that I carry, I would want to feel pretty sure that my steering wires were safely strong, and that is more than I would want to gamble on, on the machine that I saw.

By the way, I wonder how small these machines will get. Here is this little French machine that is only 18 or 20 feet across and a monoplane at that, to be sure it has to travel faster but there is no objection to that. When we get so that a man can tuck a gasolene motor and propeller under his arm and tie a pair of palm-leaf fans on his shoulders, then we little fellows can get to flying round in flocks, say at a thousand miles an hour. Sounds inviting, doesn't it?

The thing that looks to me like the most sport for the least money is gliding. All you have to do to enjoy this sport is to build an undersized aëroplane without any engine. You grab it with both hands, hold it over your head, run like sin for a few yards and jump! If you have good luck you sail away for a hundred feet or more. One man near Boston has a record of 300 feet. He does not say whether it was down hill or not, nor whether the wind was with him or not. Fact is, though, that they seem to prefer calm weather to try it in. If you don't see why, just watch a newspaper being blown around the yard. It would grate on some men's nerves to start out of Springfield on some of our northwest gales and be blown around like that without any suspicion whether they would light in Providence or Nantucket.

A Freak Substitute for X Ray

BY CHARLES WATTE

While one of the boys was testing a 3-phase starter the other day he noticed while running his hand around the inside, a queer tickling sensation in the palm of hand. He tried the other hand, then his arm but the sensation was only in that one spot. He finally came to the conclusion that a small iron splinter must at one time have pierced his hand and remained there. He then held his hand up to a large pole and the skin could be seen to raise. This satisfied him that his idea was correct. He is now wondering whether it is best to leave the iron there or cut it out.

SOME HARDSHIPS of PATENT INFRINGEMENT

Expensive Litigation Is not Necessarily Broadly Decisive

BY L. P. ALFORD

An United States patent gives the patentee the right to bring suit in Federal courts against alleged infringers of the invention during a period of 17 years. But the exercise of this right, instead of being an easy, effective manner of protecting an invention, is a tedious, expensive legal procedure, not necessarily leading to broadly decisive results.

A former article, printed on page 106, dealt with the hardships of patent interferences. In a similar way this article deals with the hardships of patent infringements. The former article was based on facts taken from the experiences of a well known independent inventor; a portion of the material for this article is drawn from the same source. The other article showed the phase of patent procedure that most clearly indicates the need of patent reform, in order to protect both the public and the individual inventor as intended by the Federal Constitution. This article deals with another phase of patent procedure which is nearly as important; for while the first dealt with certain steps of legal procedure in protecting rights to an invention prior to issuing the patent therefor, this deals with certain legal steps in protecting the rights to the invention after the patent has been issued and when the invention is being exploited by others without due license.

An Illustration of Patent Infringement

From the records of H. Ward Leonard, of Bronxville, N. Y., we have selected the following illustration as showing certain important features of patent infringement litigation. On April 30, 1901, a patent issued to Mr. Leonard, No. 673,274, dealing with controlling and safety devices for shunt-wound electric motors. Prior to its allowance an interference had been contested in connection with certain of its claims. In this interference contest one of the points raised, argued and passed upon by the examiners of the Patent Office was the question of invention. The Patent Office decided that patentable invention existed. The interference contest was brought to a close, the application was allowed and the patent issued, as we have stated above, on April 30, 1901.

On Dec. 12, 1903, Mr. Leonard subscribed and swore to a bill of complaint alleging infringement of this patent and four others by a prominent firm manufacturing electrical devices. This started the infringement proceeding on its course. The firm complained of as alleged infringers prepared the usual defendant's answer, setting up the defenses of no invention, prior public use and others. Testimony was then taken covering a period of two and one-half years. Before long it was seen that an enormous amount of complication would prevail, if all five patents mentioned in the complaint were carried through the entire proceedings. Therefore, four of these patents were dropped and the case contested in regard to patent No. 673,274. In regard to the question of invention Mr. Leonard qualified as an expert in his own behalf and called in another expert, Dr. Kenelley, professor of electrical engineering at Harvard University. On cross-examination Leonard's testimony covered 577 printed pages and his expert's 125.

In regard to public prior use two instances mentioned in the defendant's answer were put in evidence through testimony and exhibits, as well as five others which were not mentioned in the answer.

Leonard, the complainant, was compelled to visit, with his attorney, many different places to be present when the defendant was taking testimony. These places covered such widely separated points as Hartford, Conn., Chicago, Ill. and Washington, D. C. The defendant called 42 witnesses in all.

As the major part of the testimony taken by the defendant was along the line of prior public use Leonard's attorney prepared his brief and argument to deal largely with that line of defense. When the case was argued before the Circuit Court the brief for the defendant dealt almost entirely with the question of *no invention* and did not take up the question of prior use.

The Court rendered a decision in favor of the defendant. Upon appeal the case was argued before the Circuit Court of Appeals and here the defendant-appellant executed a successful about face, prepared his brief and argument along the line of public prior use, instead of along the line of no invention, the argument presented to the lower court.

The decision of the Court of Appeals was found in favor of the defendant-appellant, that is the manufacturing firm alleged to have been an infringer in Leonard's bill of complaint.

Leonard's attorney filed a petition for a rehearing which was denied.

Expense of the Printed Record

The amount of testimony taken, the length of time required in taking and preparing it and the enormous expense can be inferred by considering the number of pages of records and briefs in the printed form in which they were presented to the court.

COMPLAINANT-APPELLEE'S DOCUMENTS.

	Number of Pages.
Complainant's Record and Exhibit	104
Testimony	1863
Brief for the Lower Court	427
Supplemental Brief for the Lower Court	17
Appellee's Brief for Court of Appeals	360
Supplemental Brief for Court of Appeals	27
Total	2798

DEFENDANT-APPELLANT'S DOCUMENTS.

	Number of Pages.
Defendant's Answer and Testimony	1972
Brief for Lower Court	158
Supplemental Brief for Lower Court	10
Appellant's Brief for Court of Appeals	157
Supplemental Brief for Court of Appeals	22
Total	2319

When we consider that 85 cents per page is a common rate for legal printing we immediately estimate that the printing item for Mr. Leonard's documents in this case on appeal alone aggregated $2300; probably a minimum figure for such work is frequently done in great haste, working nights and overtime at high rates with a consequently increased expense.

It should be noted that the pages of printed record listed were prepared for the Court of Appeals, and that a similar set was prepared for the lower court.

Behind all these documents are the stenographic fees, which are frequently at the rate of 30c. per hundred words. Four hundred words per page is not an unusual number for such documents. Anyone who chooses can figure out an estimate for the cost of the stenographic work.

An important point in this connection is the complainant has no control over the length of the record. The defendant can take an enormous amount of testimony, can cross examine the witness of the complainant to practically any amount and build up an enormous record that must tend to be confusing. In the illustration the defendant called 42 witnesses, and cross examined Mr. Leonard to the extent of 577 pages of the printed record and his expert to the extent of 125 pages.

Hardships of Infringements

In infringement proceedings a multitude of defenses can be set up by the alleged infringer. Patent lawyers recog-

nize some 28 such defenses, of which perhaps no invention and two years' prior public use are the more important. When testimony is being taken an inventor may be compelled to travel the length and breadth of the country at the demand of his opponent, at the sacrifice of time, money, comfort and business interests. In the illustration cited testimony was taken in Hartford, Conn., Chicago, Ill., Washington, D. C. Is not the necessity of such extensive traveling a real hardship, especially to the independent patentee?

Another hardship lies in the law's delay. Mr. Leonard filed his bill of complaint December 12, 1903. His petition for rehearing before the Court of Appeals is dated April 3, 1909. Thus the case dragged on for over five years. During some two and one-half years of this period testimony was being taken. Mr. Leonard estimates that during four years of the time of this litigation some two-thirds of his own time, normally devoted to the inventing and patenting side of his business, was spent in connection with this infringement alone. And yet it seems true that this case has not been dragged out to an inordinate length compared with similar cases. Mr. Leonard has been involved in another infringement proceeding which was instituted as an interference in 1891 and the infringement litigation which began in 1892 has not yet reached a final settlement, although the patent has already expired. Are not such long drawn out litigations sufficient to break down the persistency of even the most vigorous independent patentees?

The question of expense we have briefly referred to above in connection with the stenographic work and printing of the records and briefs. The amount there given indicates how large these items alone may be, but they are comparatively small items when we consider lawyers' fees, expert witnesses' fees, traveling expenses, etc. In the illustration cited Mr. Leonard estimates the total cost to him was over $40,000.

In the article on interferences we pointed out the misuse of an inventor's time if, instead of doing creative work, he is fighting to protect his rights in interference contests. The same argument holds with equal strength in connection with infringements. It is clear that if an able inventor is compelled to devote his time to legal matters in connection with the defense of his patents, rather than to creative work, both he and the public at large are thereby the losers.

Another point brought out by the illustration cited above is that in spite of the fact that the Patent Office, after thorough deliberation in the interference proceeding in which a motion to dismiss on the ground of no invention was made, declared that invention existed in connection with a patent under which infringement proceedings have been instituted, this point having been brought out, controverted and settled in an interference proceeding before the patent issued, yet a successful defense was made by the alleged infringer before the Circuit Court on the ground of no invention. The prior Patent Office decision availed nothing, for such decisions have little standing before the court.

REPORT OF COMMISSIONER OF PATENTS

In closing I quote certain paragraphs from the report of the commissioner of patents for the fiscal year ending June 30, 1909, and printed in the *Official Gazette* of October 26, 1909. These quotations deal largely with recommended changes in patent procedure. Those dealing with unnecessary delays and the lessening of mistakes on the part of the office in failing to detect interferences are especially pertinent in face of the facts brought out by the preceding article.

Extracts from report of commissioner of patents: "I desire to repeat the recommendation made in my report to the secretary, dated June 30, 1907, and referred to in my report to Congress of December 31, 1908, in reference to the elimination of one of the appeals in the office."

"The present course of appeals is not well adapted to the volume of business which the office is now called upon to handle for the following reasons:

"1. It imposes on applicants an unnecessary amount of delay and expense. The very purpose of the patent system is to place at the service of the public at as early a date as practicable inventions as they are made, and unnecessary delays affect not only applicants, but all interested in the industries to which the inventions relate. One appeal within the office, together with the appeal to the Court of Appeals of the District of Columbia, would seem to be ample, especially in view of the fact that in a suit on a patent a single appeal takes the case from the trial court to the Court of Appeals. The elimination of one appeal would materially shorten the time required for the ultimate disposal of appealed cases and effect a considerable saving of expense to applicants.

"2. Section 4910 provides for an appeal to the commissioner *in person* from the board of examiners-in-chief. The work of the office and the consequent number of appeals have increased to such an extent that it has become difficult, and will soon be impossible, for the commissioner to give to each case the amount of personal attention proper to its disposal."

"Senate bill 8610 provides for the amendment of section 4889 of the Revised Statutes. Certain changes in phraseology of the statute are provided by the bill; but the really essential provision is that there shall be required to be filed with an application for patent, in addition to the drawing, two photographic copies of such drawing. This imposes upon every applicant for patent an additional statutory requirement—to wit, to file with each application of which a signed and attested drawing forms part two photographic copies of such signed and attested drawing.

"The purposes of this requirement are (1) to guard against and enable the detection of unauthorized changes in the original drawing, or abstraction of such drawing and substitution of another; (2) to lessen the danger of serious mistakes on the part of the office in failing to detect interferences between copending applications for the same invention."

"Under the present procedure, both drawing and file-wrapper are sent out of the division on attorneys' orders, also when they are placed in interference or are appealed; and the drawing is frequently sent out on orders of the official draftsman or the chief of the copy and manuscript division for extended periods, amounting, in interference proceedings, to years. While the drawing is out of the examining division interferences between the application of which it forms a part and other subsequently filed applications may be overlooked, as the interference search is made by means of the drawing. The memory of the examiner cannot always be relied upon to recall interfering applications, especially as the personnel of the force changes continually."

"The application for a patent is not a claim against the Government, and the attorney in a patent case is not prosecuting a claim against the Government. The patent, on the contrary, is in the nature of a contract and is so construed by the authorities on the subject and by the courts. The inventor having created something new, offers by his application to fully disclose his invention at once and to give it to the public at the end of seventeen years, provided the United States will allow him to have the exclusive possession thereof in the meantime. In granting a patent for an invention the Government is not parting with anything possessed by the public prior to applicant's disclosure. If the inventor chooses not to disclose his invention, but to practice it in secret, the public is the loser. In payment for the invention the inventor obtains the right to bring suit in the Federal Courts against infringers during a period of seventeen years."

A report made by the United States Geological Survey shows that the approximate value of the natural gas produced from wells and consumed in the United States in 1908 was $54,640,374, being greater than that of any previous year. The report shows that the output of natural gas was only $215,000 in 1882, and the remarkable record it has made since seems to indicate that the production of natural gas has become one of the great industries of the country.

Smith Gets the System Bug

By M. C. Jackson

Going down the street the other day I came face to face with Smith. Yes, the very same Smith who gave Brown and his system such a ripping up the back. Now, I would have slunk into a store, or even a saloon, to have avoided meeting

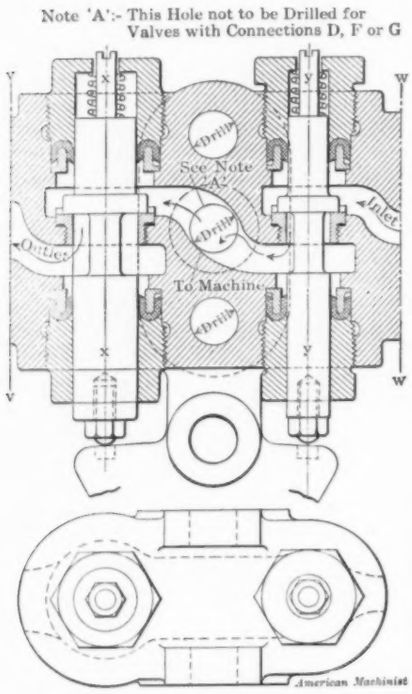


FIG. 1. VALVE PROPER. FOR CONNECTIONS SEE FIGS. 2 AND 3

Smith just at the moment, for I suspected he had blood in his eye. However, there was no escape, so I fell back on the assurance that I was no moral coward even if physically unable to put up a good scrap in case Smith wished to take payment out of my hide. Well, I put on a bold front as he grasped both my coat lapels and commenced:

"You old sinner! You wrote me up in the AMERICAN MACHINIST and exposed my contempt for system and systematizers in general. If I had met you last March my indignation might have gotten the upper hand of my esteem for your friendship.

"Laying all jokes aside, Mr. Jackson, your article brought me to a realization that I was, perhaps, too harsh on the systematizers. I have since cultivated the acquaintance of a few of them and find that most of the profession are earnestly trying to build up a fabric which will be perfection. In a way they remind me of the ancients who labored on the tower of Babylon, hoping that they might construct an edifice to reach unto heaven. As near as I can gather, the main cause of their occasional downfall is not a confusion of tongues, but a superabundance of enthusiasm; an attempt to make everything hang upon system, whether that system be best adapted to the conditions or not. They thus emulate a pair of lovers who take the longest route home. Now, if you'll come on down to the shop I'll show you some of the sort of system which pays."

Well, I couldn't get away; besides, I was some curious to know what Smith was doing, so we stepped into his den.

SMITH'S SYSTEM

"One of the principal objects of systems seems to be to determine the costs, irrespective of whether it costs more to find out what it costs than it does to actually make the part and let the costs take care of themselves in the profit and loss account of the ledger. The little systematizing that I am doing has for its object, not the ascertaining of costs, but the helping of the workman and clerical force in the ordering and production of a completed unit of parts.

"The first problem I tackled was our line of leather-packed hydraulic popper valves. For some time they had given us trouble. Nearly every machine seemed to require a different style of valve body in order that the pipe connections might have the best possible arrangement. The continual changing of the patterns became a nuisance; besides, we never knew which way the pattern was last. So I decided to give the problem some systematic thought and cover the probable range of combinations. I proceeded something after this manner:

"1. The Valve Body.

"Considering the valve body proper, having fixed upon a standard type of construction, there remained only two probable variations; namely, whether the valve should be furnished with removable seats, as illustrated in Fig. 1, or whether the seat should be part of the valve-body casting. I settled it as a fixed policy to furnish the latter unless specifically ordered otherwise by the customer.

"2. The Outlet Connections.

"After going carefully over the field it was decided that there were only seven probable styles of outlet connections, which I have shown in Fig. 2, and designated by the letters *A, B, C, D, E, F* and *G*.

"3. The Inlet Connections.

"It was found that there were but seven probable arrangements of these, as illustrated in Fig. 3, and designated by the letters *N, P, Q, R, S, T* and *U*.

"4. Number of Styles.

"Having given seven styles of inlet connections and seven styles of outlet connections there were, then, $7 \times 7 = 49$ different possible combinations or types of valves. These are illustrated in Fig. 4, which illustration I will have reproduced in our catalog. Right here let me remark that I will not be afraid to give a prospective customer the general dimensions necessary for properly arranging a machine to suit these valves *right in our catalog*. I'll try and make our catalog *give information*, not misinformation. I'm not afraid of its being an aid to our competitors; that's a minor matter. What I want our catalog to be is *an aid to our customers* and, if I devote my time to pleasing them, our competitors will have to follow suit, play trumps or lose the trick.

"5. Patterns.

"Of course, I didn't want to make 49 different patterns for each size of valve

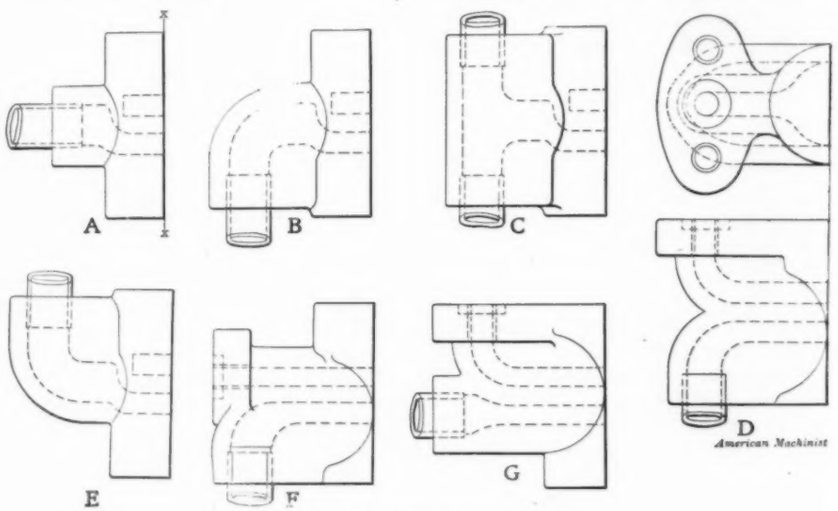


FIG. 2. OUTLET CONNECTIONS

body, so I had one pattern of that portion of the valve between the lines *xx* and *yy* in Fig. 1; then the seven styles of inlets and outlets as shown in Figs. 2 and 3 will be loose pieces. The corebox for the main portion of the body will ex-

tend to the lines *U U* and *W W* in Fig. 1, and, for the special outlet connections *D, F* and *G* a loose piece comes out of the box which will effect the purpose of joining the main core to the outlet core in the *D, F* or *G* box. I have thus secured 49 varieties of valve with only one main pattern and fourteen loose pieces. The most commonly used of these I will make now, the others as the occasion may arise.

"6. Marking of Patterns.

I have the old-fashioned pattern numbers but, in addition to these, I mark all patterns for a 1¼-inch hydraulic valve thus, *1¼-inch H. V.*, and on the loose pieces I have stamped the letters *A, B, C,* etc. Then, for the type valve shown as *A N* in Fig. 4, I call it *1¼-inch H. V. Type A N*. Now, if I was a real symbol man, I suppose I would dope it out as *H V 1¼ A N* or, perhaps, to avoid the fractions, consider ¼ of an inch as the unit and write it *H V 5 A N*. But that don't appeal to me. I find all the men know at once what the other means and, with me, that's the main thing. Get something the workman understands, something which helps him to grasp what is wanted, and he appreciates it. Give him a conglomerated assembly of letters which conveys no meaning to him and he'll treat it with contempt and have a poor opinion generally of the men responsible for its existence.

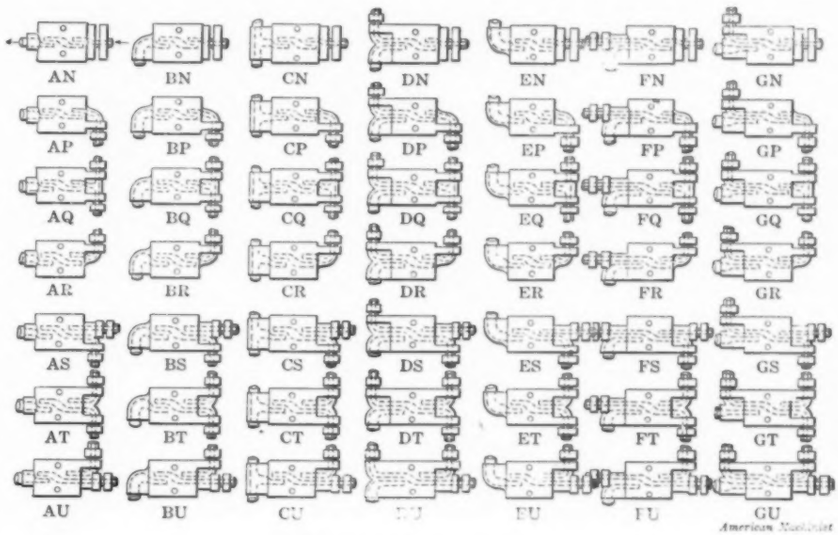


FIG. 4. TYPES OF VALVES

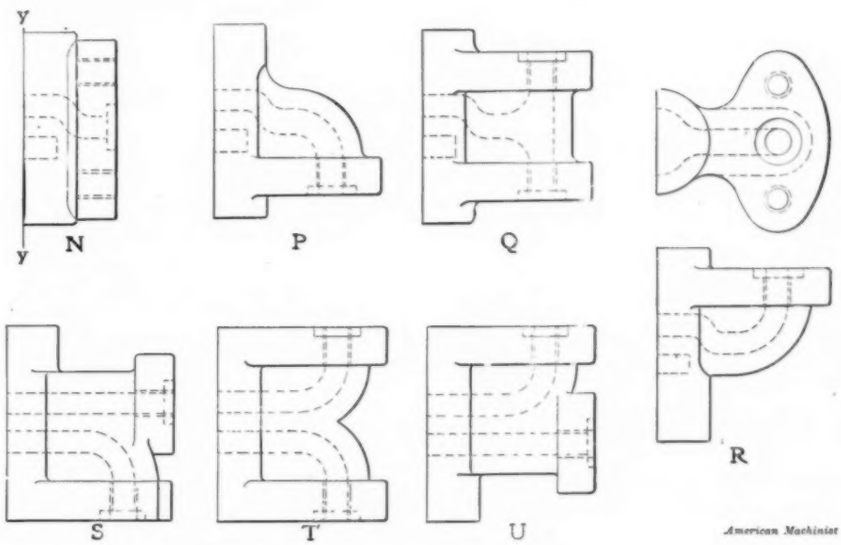


FIG. 3. INLET CONNECTIONS

"In order to show clearly how this scheme of loose pieces works out in ordering the detail parts it is necessary to explain briefly my system of pattern numbers, which is as follows:

"The pattern number is the same as the drawing number except that it is preceded by a letter, commencing with *A, B, C,* etc., using all letters, if necessary, excepting *I* and *O*. Thus if 532 is the drawing number *A*532 is first pattern on drawing 532. *B*532 is second pattern on drawing 532. When one pattern makes several different castings by using loose pieces, stopping-off pieces, etc., add a letter to the pattern number of the pieces to indicate this; *A* for the first loose pieces, *B* for the second, etc. Thus, *A*532 is plain pattern, *A*532*A* is pattern *A*532 with loose piece *A*, *A*532*B* is pattern *A*532 with loose piece *B*, *A*532*AB* is pattern *A*532 with loose pieces *A* and *B*. In the case of the valve body shown in Fig. 1, for type *AN* the complete pattern number of the body is *A*532*AN*.

"When an alteration is made to an old pattern the pattern preserves its original number but has prefixed a number, 1 for the first change, 2 for the second change, etc., thus: 2 *C*640 indicates the second change on pattern *C*640. If this change is indicated on some other drawing than 640, go back to drawing 640 and refer by note to the new drawing for the change.

"When a slight permanent change is made in a pattern and yet leaves the pattern in such shape that a repair part for previous work could be ordered from the changed pattern, no number will be affixed to the pattern number to indicate such a change.

TYPES CARRIED IN STOCK

"Now, it would, of course, be foolish to carry 49 varieties in stock, so I decided that the two types most used were types *AN* and *BP*, and thus decided to carry these styles of body in stock and make up the other styles as needed, always carrying the stems and other small parts ready for assembly in any type of body."

I had been a good listener thus far, but must needs ask a question here.

"Mr. Smith, that all sounds good to me excepting the last part. You have your 'Heinz's 57 varieties' on paper, but it seems you have yourself decided that only two are worthy of being carried in stock. Now, what's the use of the other 55 varieties?"

Smith: "Now, I'm due elsewhere in a few minutes and you can't draw me out further today, but if you want an answer to your question, go out in the shop and look at some of the machines we're building and you'll think the valve grew on the machine. They're all arranged just to suit their specific location. After that, go over to Brown's and look at some of the contraptions they put out. If you're still alive, go home and write a story about it; it will do you good. And say, you can have this blueprint to illustrate your story; that'll keep you from making pictures of me. Now, don't forget to tell them that there's two kinds of system: the sort which befuddles the mind, worries the workman and increases the overhead charges; and the sort which the workman understands and considers a help to him."

MOLDING PATTERNS in FOUNDRY FLOOR

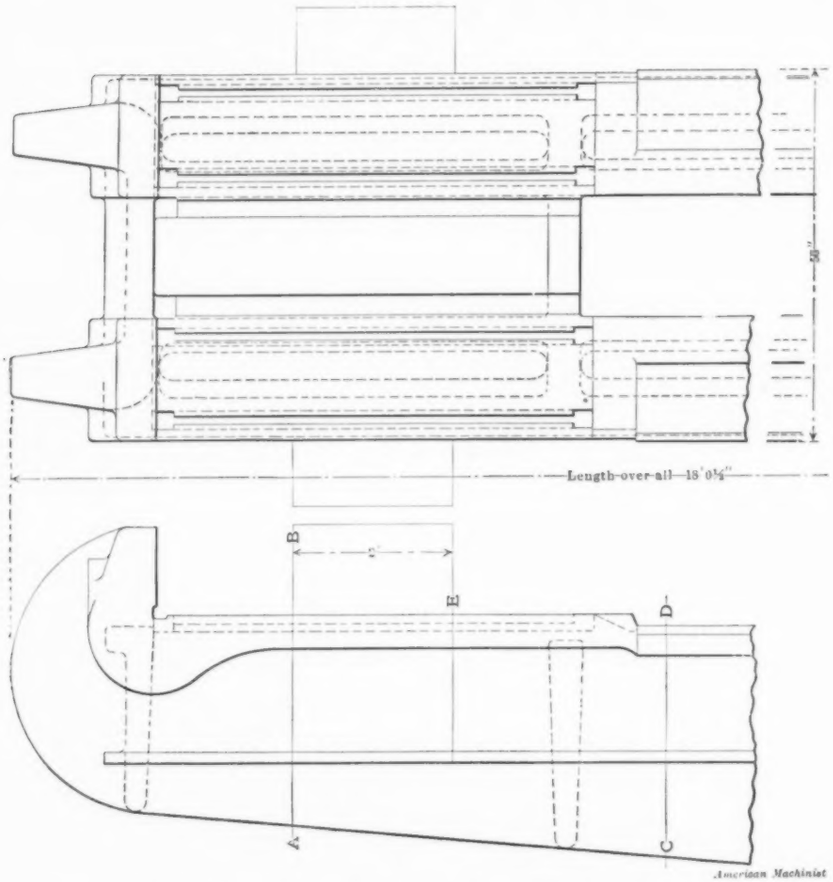
The Solving of Problems in Casting by Interesting Kinks and the Use of Side Cores

BY JABEZ NALL

By floor molding we mean the making of castings, the pattern for which is either too large to put in a flask, or of a shape that makes it either inconvenient or too costly to do so. This may be due to the fact that but a few are to be made, or to the capacity and equipment of the foundry for the handling of the work, and, therefore, the pattern is bedded in the foundry floor; only such parts as come above the main parting line being put in a cope flask.

The castings to be made may be simple or intricate as the case may be, the molding of some being on the lines of the common everyday practice, while others, by reason of difficulties presented require a distinct departure form these lines. It is the overcoming of these difficulties that presents problems of more or less interest to the patternmaker and to the molder.

The making of large castings is always interesting if for no other reason than that of size and weight; but often other considerations give an added interest, to wit, the making or changing of the pattern, or a departure from it by making a mold that will produce a casting differing from the pattern. Such a case is illustrated by a "bulldozer" frame casting as made by the Ajax Manufacturing Company, Cleveland, O.



FIGS. 1 AND 2. CASTING TO BE MADE 2 FEET SHORTER THAN PATTERN

These patterns are made in standard sizes but to meet a special case a casting of one of the larger sizes was required with two feet less of die space. It was thought undesirable to cut the pattern, so some way had to be found to avoid this and produce the shorter casting. The problem was solved as illustrated in Figs.

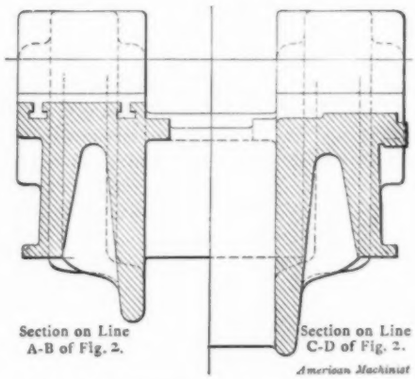


FIG. 3. SECTIONAL VIEW OF CASTING

1 to 5. Figs. 1, 2 and 3 show a part plan, part elevation, and cross-section, respectively, of the casting to be made; Fig. 4 a longitudinal section of the mold under construction, with the pattern in position, and Fig. 5 a similar cross-section view.

DIFFICULTIES ENCOUNTERED

If this pattern was to be molded entirely in a flask; it would be possible to

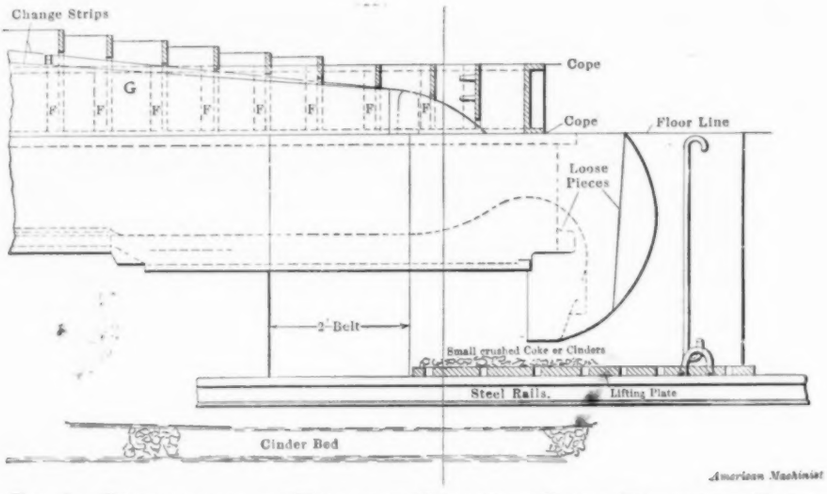


FIG. 4. CONSTRUCTION OF MOLD WITH BULLDOZER FRAME PATTERN IN PLACE

arrange the sections of the flask, so that an intermediate section of 24 inches could be inserted between the main sections at the correct point and a parting formed at each side of this, then after the pattern was withdrawn, before finishing the mold, this intermediate, or dummy section of the flask could be cut out, and the main sections brought together, thus shortening the mold the required amount. But the pattern being bedded in the floor the problem is not so simple.

It is still necessary that the lower or drag part of the mold be in two parts; one stationary and one movable, and that means be provided for cutting off the required amount and insure the correct abutment of the two, when the movable section is replaced.

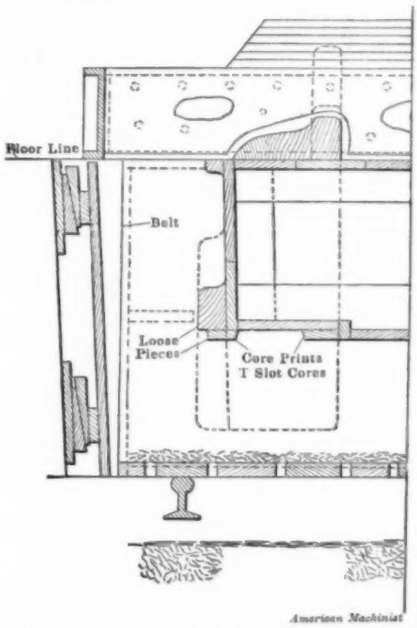


FIG. 5. CROSS-SECTION OF MOLD

It would be possible for the molder to do this almost entirely, if not altogether so; but a little time spent in the pattern-shop will insure accuracy, as well as simplify the molding operations, and the time thus spent will be regained in the foundry.

ALTERATIONS ON PATTERN

The patternmaker made a 24-inch wood-belt (so called for want of a better term) on the two sides and beneath the pattern for the space between the lines *A*, *B* and *E*, Fig. 2. This was made 10 inches out from the body of the pattern and of a sufficient depth to allow 5 inches of space for sand between the lifting plate and the lowest point of the pattern. This belt was made in three sections to allow the separate removal of the body of the pattern, and also to facilitate its own removal from the sand, later. Its construction was simple, being merely a box of 1-inch lumber, well braced internally. The patternmaker also arranged the cope section of the pattern by changing the position of the cross ribs *F*, Fig. 4; shortening the longitudinal ribs *G*, and making temporary strips *H* to correct the outlines of ribs *G*.

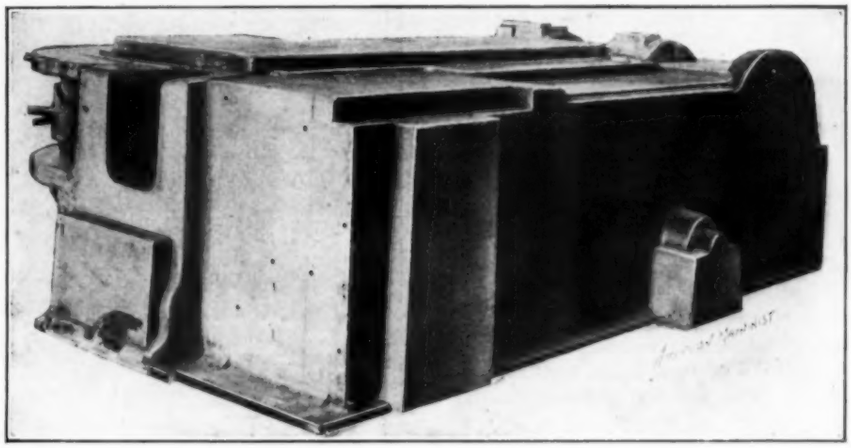


FIG. 6. PATTERN READY FOR MAKING CASTINGS SMALLER IN WIDTH

As these ribs were made in sections, and loose in the cope this was a simple matter. Some of this work could have been omitted, had it been thought advisable to roll the cope for finishing. As it was to be finished overhead, however, it was thought best to give the correct impression at first, without any added changes by the molder.

APPARATUS FOR MOLDING

The preliminary operations in molding this pattern followed the usual practice for "bedding in" the pattern, and for a skin-dried mold for a large casting. Such preparations consisted of binding plates and hooks; arranging a cinder bed to vent to; the setting of vent pipes to carry the gases above the floor line and beyond the lines of the cope, and the making of the first ramming of sand above this.

This brings us to the part that first affects our problem, that of stopping off two feet of the central part of the mold. First two rails were bedded in the sand and made level, as shown in section in Fig. 5. Upon these rails rests the pattern at the line of the wood belt, also a cast-iron lifting plate, with three eyes cast in for lifting hooks that are long enough to reach the floor line.

The plate was made to extend 16 or 18 inches beyound the line of the pattern to allow for a good rodding of the sand, which had to be built extra strong on account of its removal. A number of holes were cored through the plate for vent purposes; but to insure the free

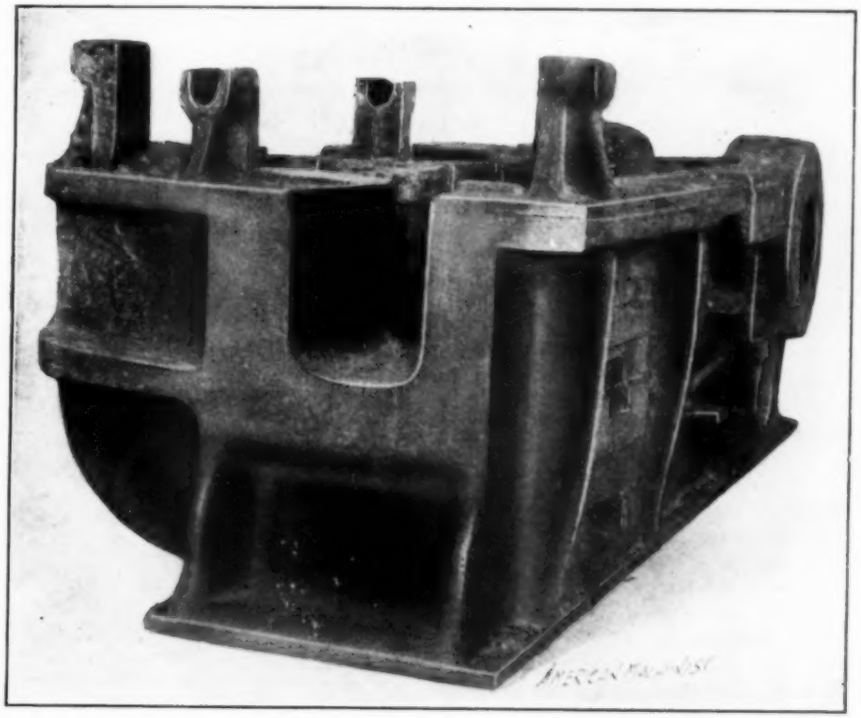


FIG. 7. CASTING AS IT COMES FROM STEEL FOUNDRY

and quick passage of the gases a layer of cinders was placed on the plate and connected with the space above by vent pipes.

Two Ways for Ramming Movable Part

In preparing for the ramming of the movable part of the mold, there are at least two ways that this can be done and about the merits or de-merits of both, experts may be expected to differ.

The hole—with pattern in position—may be rammed up full and afterward the part to be moved can be separated from the floor by digging around it; see Fig. 4. This was the course pursued for this casting.

The other way is to make a parting by placing boards or plates as shown in Fig. 5. These should be well braced to insure good ramming. This is the course I would prefer and if suitable plates are at hand it is considerable of a time saver over the first, and in my opinion is altogether preferable.

Ramming Up the Pattern

With the Wood belt and lifting plate in position, and the preparations for ramming made, the seat for the main body of the pattern was next made. This center section of the belt with its upper edge, conforming to the lines of the underside of the pattern, gave a good and correct guide for the forming of this seat, with the aid of a straight-edge and level.

The seat having been formed, the body of the pattern was set in position and all loose parts set in their respective places. The ramming was then continued to the top. The cope was made as ordinarily and when this was removed the pattern was withdrawn as were also all loose parts, together with the wood belt.

The movable section of the mold was then loosened up and slightly raised so it could be carried forward until it abutted the main or stationary section of the mold. The parting fitted and lined up in good shape, and this part of the mold was secured in place. After this all other molding operations followed the regular practice.

This solution of the problem may not be new to everybody, but it will be to some, and if others have a better way the columns of the American Machinist are open, and I for one would be glad to hear about it.

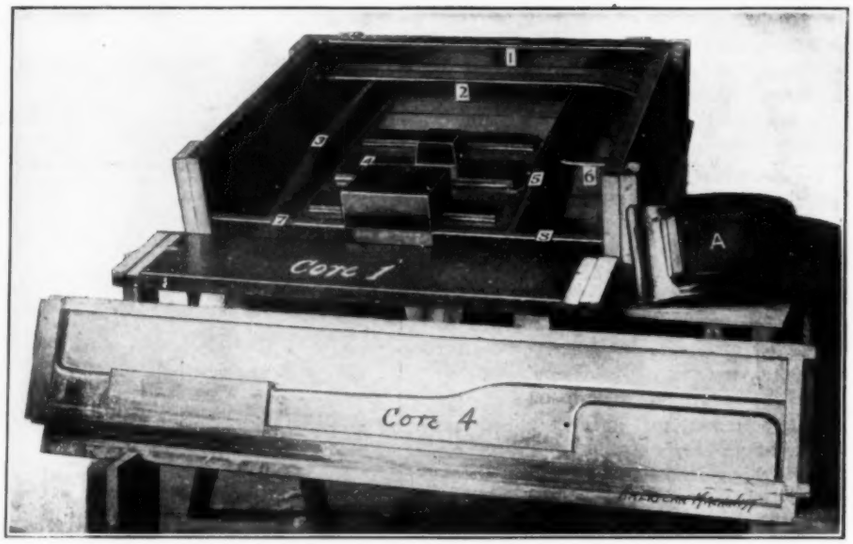


Fig. 8. Boxes for Cores 1 and 4. Loose Piece *A* of Pattern

Pattern and Casting of Another Job

Another interesting job is the making of a narrow casting from a wide pattern. It differs from the other by cutting off the outside instead of taking out the middle, which on the face of it would seem a much simpler proposition.

This problem is capable of different

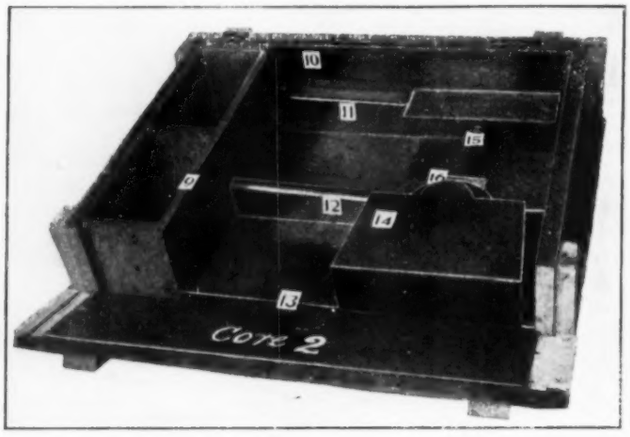


Fig. 9. Core Box as Set Up for Core 2

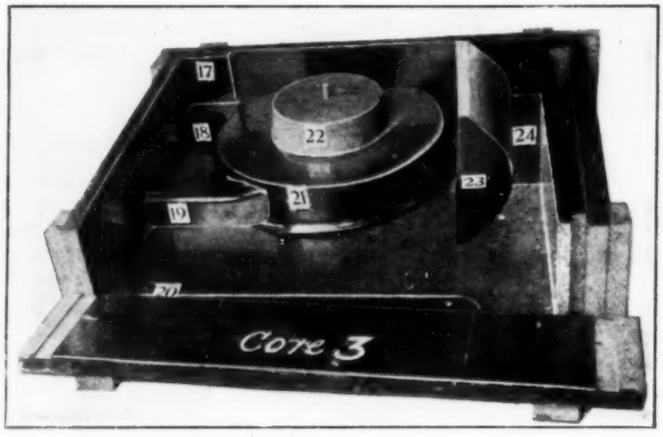


Fig. 10. Core Box as Set Up for Core 3

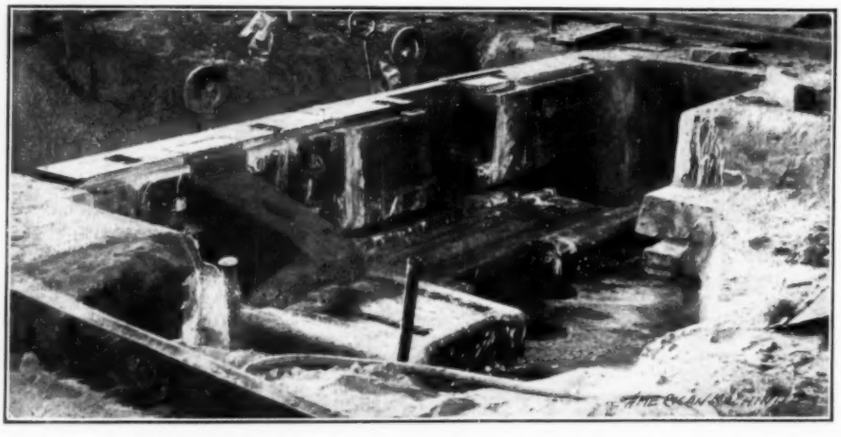


Fig. 11. Inside of Mold with Stop-off, Side Cores Set

methods of solution, that in the end give the same result. The best method is the one that combines simplicity with economy and safety.

In Fig. 6 is shown a view of the pattern used, piece *A* being added to the pattern to form the upper part of the crank-shaft boss required on the casting. It also indicates the width of the casting that is required, the face of the pattern, as shown, being the part to be stopped off.

In addition to piece *A* a core print was added to the pattern for core 4 in Fig. 8. This determines the line of the casting as will be seen later. In Fig. 7 is shown the casting as it was received from the steel foundry. The method decided on as best meeting the requirement was that of forming the blank side of the casting by a line of cores and filling the space with heap sand rammed solid.

Core Boxes

In Figs. 8, 9 and 10 are shown the same core-box frame and bottom board, arranged for different cores, Nos. 1, 2 and 3; the other numerals signifying the different change pieces. In Fig. 8 is also included loose piece *A* before referred to, as well as core print and core box for core 4.

These are all self-explanatory as to construction. Nos. 1 and 10 refer to the same stop-off piece placed for cores 1 and 2. Piece 9 is a stop-off piece, also to give core 2 the required length. Piece 24 does the same for core 3 and conforms to the line of the end of the pattern, shown in the rear of Fig. 6. This completed the work of the patternmaker as it directly affects our problem.

Fig. 12. View of Mold Showing Back of Cores 1, 2 and 3

In Figs. 11 and 12 is shown the mold in different stages of completion, and from different angles. In Fig. 11 the mold has progressed as far as the setting of the lower strata of cores. The anchor or drawback is removed and the next thing in order is to prepare for its replacement. In Fig. 12, taken from the opposite corner, this is shown replaced but not secured, and cores 1, 2 and 3 are shown just before they are secured by ramming up the space shown in the foreground.

Setting the Cores

In the setting of the cores the first ones placed are the line of stop-off cores, and of these the first is core 4, which fits into a print formed by the print shown. This core gives the correct location for cores 1, 2 and 3, which set even with it at the back, and when lined up conform to the same metal line. These in place, the joints were made up as seen in Fig. 11, and all fins or seams thus avoided This method fulfilled the conditions and the result was all that could be desired.

One thing will be noticed which is, that there is nothing in these views to show how the lugs were molded, for the tie bars that appear on the top of the casting in Fig. 7. These were formed by cores into which the pattern was set at the commencement of molding operations. The use of cores without prints for this and other problems in molding make up another story.

Limits for A. L. A. M. Threads

By J. Coapman

An automobile manufacturing firm which builds in large quantities has been having considerable trouble in the past with screws, bolts, studs and nuts. It seems that bolts, screws and studs would come a trifle too large in diameter and in order to evade the inspector the workman would use a file to bring the outside diameter correct. This company has no bench inspection but quite a staff of floor inspectors.

Finally the matter became so serious that it was brought to the attention of the engineering department and they were requested to devise some means of overcoming the trouble. They decided to give the dimension of the pitch diameter in the future with the necessary limits instead of the outside diameter.

Below is a table giving the pitch diameter and the limits for A. L. A. M. screws. The United States standard thread is used but not the A. S. M. E. standard.

Since adopting this method considerably less trouble has been experienced as the inspector can tell immediately whether the screws are properly made or not. If the pitch diameter comes correct the outside diameter must be correct also.

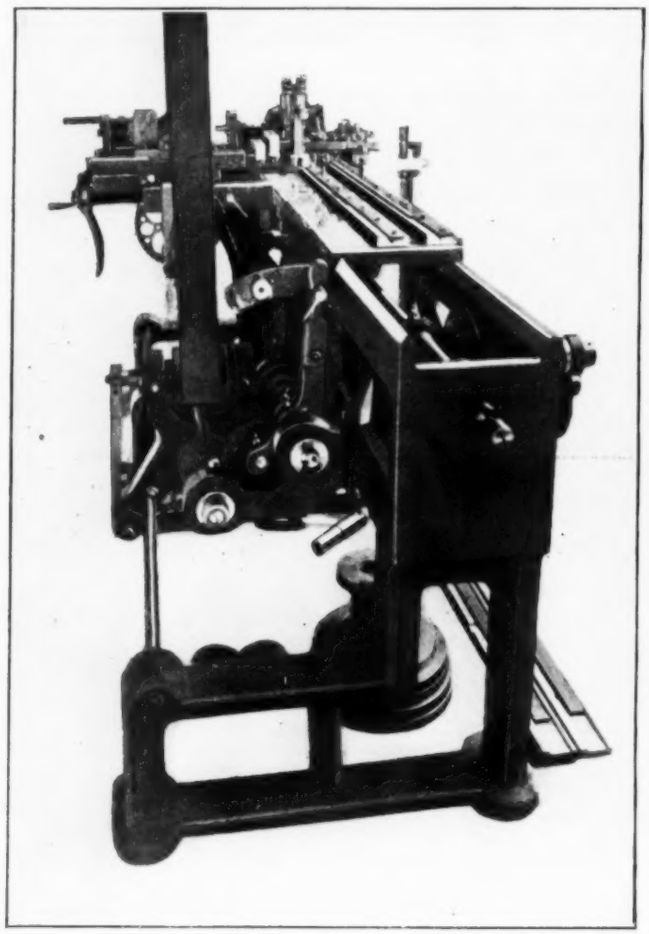
Nominal Diameter.	Pitch.	$\frac{0.6495}{P}$	Stud End.	Nut End.
$\frac{1}{4}$—0.250	28	0.0232	$+$ 0.227—0.001	$+0$ 0.225—0.001
$\frac{5}{16}$—0.3125	24	0.0271	$+$ 0.285—0.001	$+0$ 0.283—0.001
$\frac{3}{8}$—0.375	24	0.0271	$+$ 0.347—0.001	$+0$ 0.345—0.001
$\frac{7}{16}$—0.4375	20	0.0324	$+$ 0.405—0.001	$+0$ 0.403—0.001
$\frac{1}{2}$—0.500	20	0.0324	$+$ 0.467—0.001	0 0.465—0.001
$\frac{9}{16}$—0.5625	18	0.033	$+$ 0.526—0.001	$+0$ 0.524—0.001
$\frac{5}{8}$—0.625	18	0.036	$+$ 0.589—0.001	$+0$ 0.587—0.001
$\frac{11}{16}$—0.6875	16	0.0406	$+$ 0.647—0.001	$+0$ 0.645—0.001
$\frac{3}{4}$—0.750	16	0.0406	$+$ 0.709—0.001	$+0$ 0.707—0.001
$\frac{7}{8}$—0.875	14	0.04639	$+$ 0.828—0.001	$+0$ 0.826—0.001
1—1.000	14	0.04639	$+$ 0.953—0.001	$+0$ 0.951—0.001

PITCH DIAMETER MICROMETER READINGS.
A. L. A. M. Threads.

A series of experiments by the Bureau of Standards, Department of Commerce and Labor, in order to determine thermal properties of materials, at high temperatures, is of considerable technical interest. Some preliminary observations have been made upon iron and copper, but further work has been postponed until the greater facilities of the new heat laboratory, now in the course of erection, are available. It is hoped, in the course of these experiments to make measurements on aluminum, brass, bronzes and special steels, and the results of these tests, when published, will no doubt throw much light on the subject.

Automatic Dividing Machine *By Dr. A. Gradenwitz*

A novel longitudinal dividing machine which can be operated by electricity or any other agent, has been recently constructed by George Kesel, of Kempten, Bavaria. This automatic machine has a range of 120 centimeters and allows two divisions of the same length to be made simultaneously, the capacity being 1800 to 2400 strokes per minute. However, in the event of a number of short divisions having to be made, as in the case of sliding gages, up to three cutting frames can be placed on the machine simultaneously, allowing six sliding gages to be divided at a time.



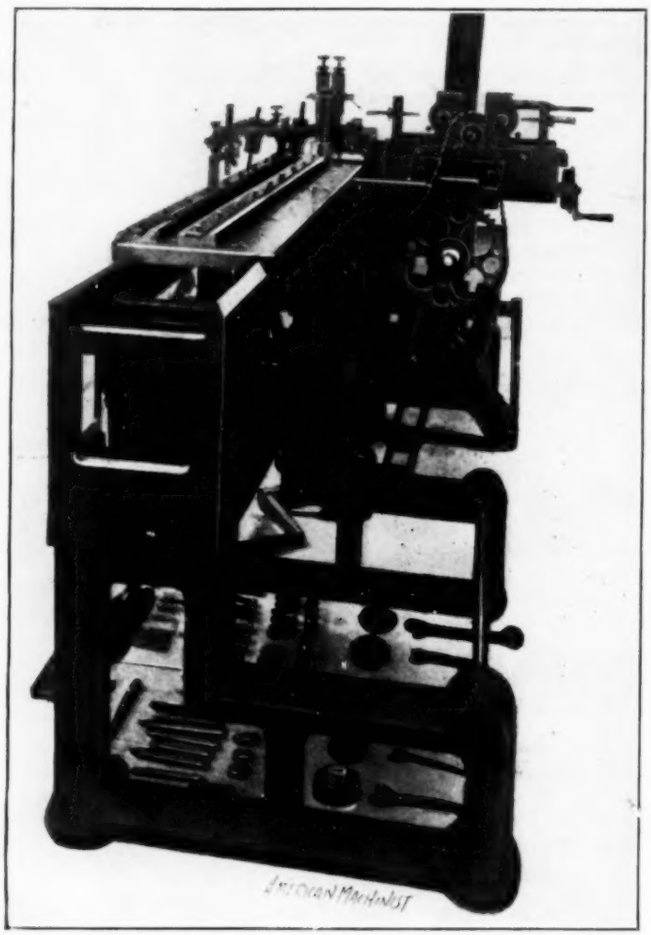


FIG. 1 AUTOMATIC LONGITUDINAL DIVIDING MACHINE FIG. 2

GRADUATIONS OBTAINABLE

This machine is constructed for any measuring unit and its subdivisions, that is, for millimeter, ½ millimeter and ¼ millimeter divisions, or for 1 inch line, ½ line and ¼ line divisions, or for ½ centimeter divisions, ¼ inch divisions, etc., as well as for verniers. For the latter and for very short or experimental scales a hand crank, fitted to the square end shaft visible in Fig. 3 is provided. The handle visible below the squared shaft end allows the mechanical drive to be thrown in by a downward pressure, while the cutting out is effected either by mechanical or electrical means. On the top of the cutting frame is fitted a stroke-meter, adjusted by hand to any given number. In order to divide a meter scale into millimeters, that is, to draw 1000 strokes, all that is required is to adjust the stroke meter to the number 1000, and to throw the handle downward. The machine then will draw its 1000 strokes automatically and stop after the last stroke. If, again, 16 lines per inch have to be divided on a slide gage of 8 inches, by tracing $8 \times 16 = 128$ strokes, the cutting frame having been adjusted to this division, the stroke-meter should be adjusted to 128, when the cutting frame will be released automatically with the 128th stroke. In the case of very short scales, the stroke meter is thrown out, the button visible on the front side in the middle of the machine being used in its place: by pressing this button after the division has been completed, the machine is stopped instantly. There is, furthermore, an additional disengaging device which is mainly used for emergency purposes.

THE ADJUSTING WHEEL AND THE MICROSCOPE

In the middle of the machine is a handwheel provided with a drum divided into 100 divisions, which allows 1/100 millimeter to be read. This handwheel allows the whole of the cutting frame to be shifted to the right or left, up to about two or three centimeters, both when the machine is at rest and in operation. This shifting of the cutting frame offers an important advantage, as the first stroke has frequently to be traced on a given mark. In this case, the cutting frame is shifted, by means of the handwheel, until the mark and the adjusting microscope (which has been previously brought into agreement with the graving tool) coincide with the first stroke of the division. Again, if during operations the point of the graving tool should break, this device allows it, after being ground

up again, to be accurately adjusted to the stroke previously traced.

However, this handwheel is even more valuable in tracing precision scales, for the following reasons:

COMPENSATING FOR VARIOUS MATERIALS

The spindle or screw of the dividing machine has been cut with a view to its being correct in its total length at zero Centigrade. As other materials, such as brass, have a different coëfficient of thermal expansion than steel, a brass meter gage would not be absolutely correct when divided in accordance with the spindle. However, calculation allows the number of hundredths of a millimeter by which the division on the brass rod should be corrected, to be ascertained readily, and this difference, which, at given temperatures, in the room, may be, for instance 10/100 millimeters, should be distributed uniformly during operation by means of the handwheel. In the instance mentioned, by adding one hundredth of a millimeter to each 10 centimeters, thus insuring a perfect correctness of the brass meter at zero Centigrade.

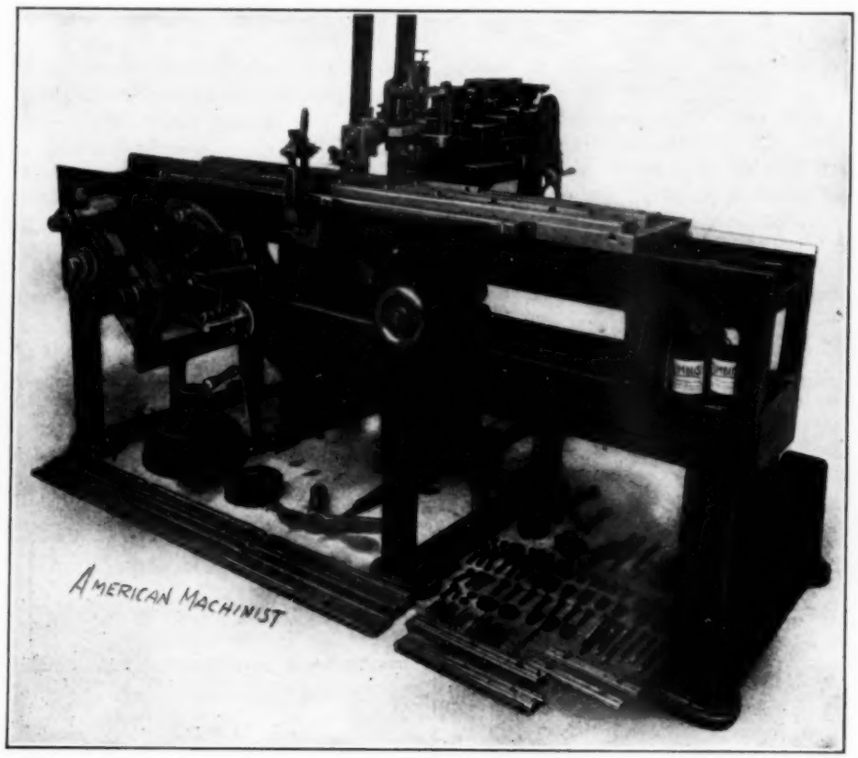


FIG. 3. AUTOMATIC LONGITUDINAL DIVIDING MACHINE

The microscope visible in Fig. 3 allows the accuracy of the work to be checked at any moment, by comparing the division of the scale to be divided with a standard metric or Inch scale placed beside it. The screw located within the bed of the dividing machine, has a pitch of 5 millimeters and is located between case-hardened points. Above the screw is arranged a protective case which is not represented in the illustrations. The split brass nut allows the table to be engaged or disengaged by a simple manipulation.

GEAR DRIVE, FRAME, ETC.

In Fig. 1, bevel gears are shown by means of which the screw can be adjusted for traveling in right-hand or left-hand direction.

The cutting frame, as seen from Fig. 2, is of substantial design, and can be shifted at will throughout the width of the table by a screw of one millimeter pitch, and a drum allowing 1/100 millimeter to be read. The load on the cutting frame in tracing fine or coarse strokes can be regulated by springs. The cutter frame gives automatically three positions, represented in Fig. 4, both for millimeters and inches, the length of strokes being varied at will. The drive of the cutting frame is seen in Fig. 2. By throwing in another change wheel by means of the hand lever, the sliding gear can be made to draw the table forward twice, with the gage to be divided, while the cutting frame only traces one stroke. This is required, in connection with gages with divisions comprising larger intervals, such as ½ centimeter divisions.

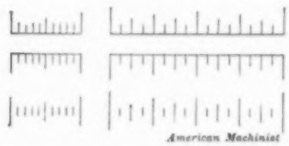


FIG. 4. FORMS OF GRADUATIONS

Navy Yard Examination Questions

By L. Webster

Men may come and men may go but government examinations go on forever. The nature of the questions asked at these examinations seems to be unlimited both in scope and mixture of subjects. But however hard the applicant may squirm or protest in order to make any advancement worth while he must become informed on general engineering problems. He should know something, the more the better, of steam engineering, gas engines in theory and practice, electrical engineering, and applied mechanics. He should know how to read a working drawing and be able to make drawings that will fairly illustrate his ideas. It is an old story for machinists to state that they know a subject or a process perfectly but that they can't express it in writing. But most examinations have to be written, therefore it is up to the machinist to learn how to express himself in writing.

The following list of questions was given recently to machinists wishing to enter a government service.

EXAMINATION QUESTIONS

— for —

QUARTERMAN OR LEADINGMAN MACHINIST,

U. S. Navy Yard, Charleston, South Carolina

(1) You are placed in charge of a machine shop employing 100 men, and doing general ship-repair work, and building one sea-going tug. Give the organization you would effect; that is, the number of men in each rating including the supervising force. State the general classes of work you would consider each rating suitable for.

(2) You are ordered to examine the steering engine of the "Solace" and to report on same. State in detail what troubles you would expect to find, and how you would go about to repair same. Explain the differential gear of a steering engine.

(3) Sketch a shop suitable for the force mentioned in question No. 1, for machine-shop work only. Indicate tool rooms, and all machines and appliances for the proper working of the shop.

(4) Discuss the advantages and disadvantages of belt and motor drive. What class of machines should be belt driven? Why? What class of work is done on an engine lathe? On a turret lathe?

(5) You are furnished a rough propeller casting. State how you would finish it in all respects, the blades to be finished smooth. What machines would you require, and how would you place your work in them? If the propeller is for a battleship, diameter 15 feet by 2 feet width of blade, make an estimate of time and cost to finish as above noted.

(6) If a triple-expansion engine with four cylinders has a 14-inch high pressure cylinder, what size approximately would you expect the others to be? Why do they make triple-expansion engines with four cylinders? What stroke would you think suitable for the above engine? What style valves would you recommend for such an engine, and sketch same. Make a sketch showing arrangement of cylinders. Why arrange them in this manner?

(7) Given a single-cylinder engine of the following dimensions, diameter 24 inches, stroke 27 inches, pressure 1101 pounds, piston-rod diameter 4 inches, revolutions per minute 120, what is the horsepower? (Neglecting friction, etc.)

(8) Give a detailed estimate of time and cost for making a connecting rod and crank brasses, as per sketch. Give weight of various materials used, the composition of the material in the brasses, the machines used in making same, and the time required on each machine.

(9) Give the weight per cubic foot and tensile strength of the following materials: Cast iron, mild steel, copper, composition "G," tobin bronze and lead. How do you find the area of a circle, given the circumference; the area of a triangle; of a rectangle; the volume of a sphere? A plate of steel is 9/16 inch thick, 18 feet long, 3 feet wide at one end, and 3 feet 6 inches wide at the other end. How much does it weigh?

(10) You are to buy a new 18-inch engine lathe for general work; what attachments would you require? Explain by sketch the Le Blond quick-change gear of a lathe. Explain by sketch the quick-return mechanism of a slotter.

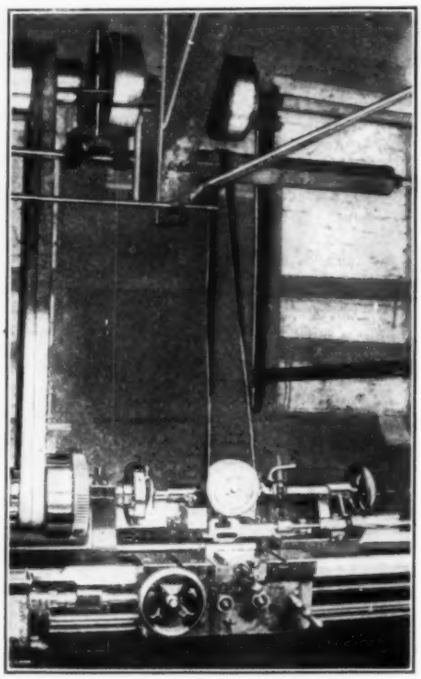
Allowing for Shrinkage in Hardening

By O. S. Bickford

We are using a rather interesting scheme for "stretching threads," that is, cutting them with a pitch a trifle long to allow for shrinkage in hardening. We are using a quantity of quills, and nuts for the same, having a variety of pitches and the thread having its lead "stretched" usually about 0.030 inch per foot. This is done by milling the threads on a lathe having a compound rest, using a milling device on the tool block which we drive from a drum overhead. The work is placed in the lathe in the ordinary way, being driven very slowly by means of a worm running in mesh with a worm gear mounted on the regular countershaft as shown above.

The stretch of the thread we get by turning the compound rest around to bring its screw in line with the ways of the lathe, then attach to the end of this screw a rod which carries a shell which has two spiral grooves milled on opposite sides. This shell travels through a bushing supported by a special bracket attached to the tailstock of the lathe. This bushing has two pins projecting inwardly which engage in the grooves of the shell, so that as the lathe carriage advances the screw of the compound rest is turned, thus advancing the tool block relative to the carriage, the amount of the stretch being determined by the lead of the spiral sleeve. The bushing through which this sleeve travels is easily released to allow for turning a little to take up slack when starting at the end of the cut. The rod referred to is smaller than the hole in the sleeve, being held to position lengthwise by two collars, one at each end of the sleeve, the one at the rear, entering and being splined to the sleeve; the rod being free in the forward end of its sleeve allows for a cross movement of the carriage for taking the depth of the cut.

We also use a short collar having two set screws to connect the rod and screw in the compound, making it very easy to disconnect the rod and run the carriage away to try the work, this being done by simply loosening one screw, when the shell and rod can be drawn back (spirally of course) but will return to the exact same position without disturbing the screw of the compound rest. This feature we find very desirable when doing inside threading.



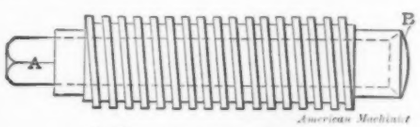
ALLOWING FOR SHRINKAGE IN HARDENING

There are several plans used on a regular lathe for stretching the lead of threads and while this may not be new to some of your readers, we never had seen or heard of it, and it certainly gives us a uniform stretch of lead in a very satisfactory manner. The illustration shows the device in use as well as the overhead changes necessary to operate the same.

Repairing a Broken Chuck Screw

BY D. P. MADSEN

Someone broke the square end off the chuck screw. The factory was a thousand miles away and the chuck needed at once or sooner. I drilled a hole from end to end, the size of the square across



A CHUCK-SCREW REPAIR

the corners and fitted the piece *A* a tight drive fit in the screw and riveted it over at *B*. After the end was squared for the wrench the screw was as good as ever.

In a paper presented before the American Society of Mechanical Engineers dealing with lubrication and lubricants it is noted that proper lubrication of bearing surfaces involves careful consideration of the metals composing the journal and bearing since the influence of the metals employed has an effect even in the intervention of the best lubricating film. The materials in common use for the construction of bearings include cast iron, steel and alloys of variable composition included under the general terms, bronze and babbitt. Tests in cast-iron and bronze bearings did not seem to perfectly prevent injury to the journal, while the paper states that a properly selected babbitt for a steel journal seemed to fulfil the desired conditions.

LETTERS · FROM · PRACTICAL · MEN

Concerning the Details of making things in machine shops, from the first sketch to the sale

Errors in Screw Thread Constants

Having been in a position to see several special forms of screw thread made where one or more men are continually making taps and dies to produce these threads in novelty work, and knowing some of the errors made in calculating the depth, double depth and pitch diameter, I think it will be of some interest to the readers of your paper to know what some of these errors are.

A short time ago I had to make a spring-threading die having 28 threads per inch and having an angle of 66 degrees V sharp. I called upon the boss tapmaker for the constant for finding the double depth of a 66-degree V sharp thread, not wanting to stop just then to figure it myself. He hesitated, thinking, I suppose, he held one of those shop secrets, then gave me the figures 0.83867, which is the cosine of half the angle of the thread I was to cut. He also said that if I wanted the double depth, to multiply this by 2, giving 1.67734 and to divide this by the number of threads per inch.

To show me the figures he gave me were correct, he told me to look up the cosine of half the angle of a 60-degree V sharp thread and multiply it by 2.

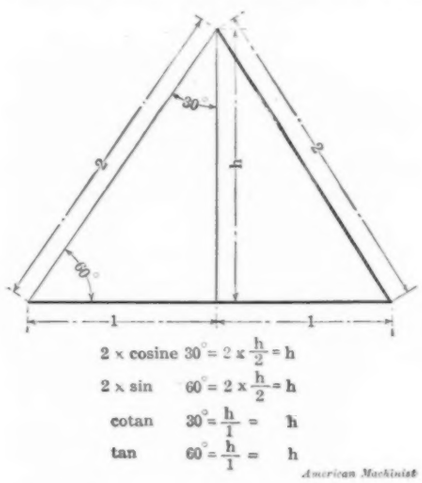


FIG. 1. RELATIONS OF FUNCTIONS OF 30-DEGREE AND 60-DEGREE ANGLES

Thus; cosine 30 degrees = 0.866025, $0.866025 \times 2 = 1.73205$, which is the constant given in catalogs and hand books for finding the double depth of a 60-degree V sharp thread. This is just where the error was made for it is to be noted that twice the cosine 30 degrees and twice the sine 60 degrees, are the same as the cotangent 30 degrees, and the tangent 60 degrees. This is clearly shown in Fig. 1.

The cotangent of half the angle is the constant for calculating the double depth of V sharp threads of any angle, that is, double depth equals constant divided by number of threads per inch (Fig. 2). If not sharp, the sum of such amounts as are taken from the top and filled in at the bottom must be subtracted from the V sharp depth and multiplied by 2 for double depth. A constant may then be gotten by multiplying the double depth of the sharp thread by the number of threads per inch and this constant will then serve for all numbers of threads having the same form as that from which it was derived.

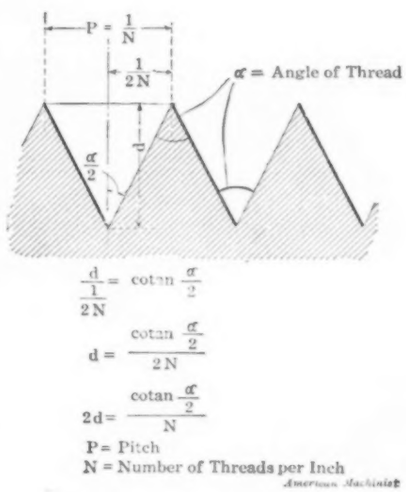


FIG. 2. DERIVATION OF THREAD CONSTANT

To more plainly show some of the errors mentioned above, we will take for examples three cases of internal threads of 40, 60 and 80 degrees, all V sharp, ½-inch pitch.

Of course these errors are very slight when the angle does not vary much from 60 degrees and is of fine pitch. For example, with a 64-degree V sharp thread having 30 threads per inch, the error on a side is only 0.00319 inch. This possibly would not be noticed in ordinary practice on a large diameter, as this would make the bore about 0.0063 inch small.

Taking up the first case, as in Fig. 3, 40-degree V sharp thread, two threads per inch; cotangent of half the angle $\frac{40}{2}$ = 20 degrees = 2.74748.

$$Depth = \frac{2.74748}{2 \times 2} = 0.68687 \text{ inch on a side.}$$

Now using twice the cosine for the constant for calculating the double depth,

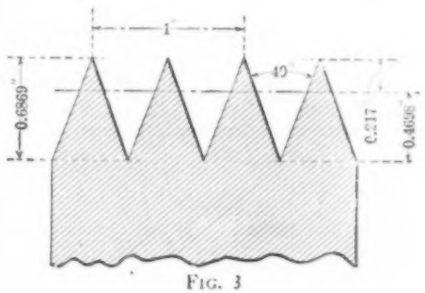


FIG. 3

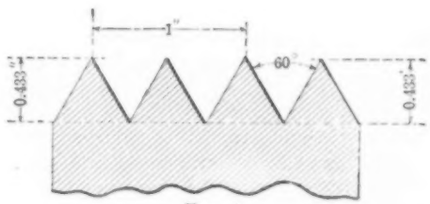


FIG. 4

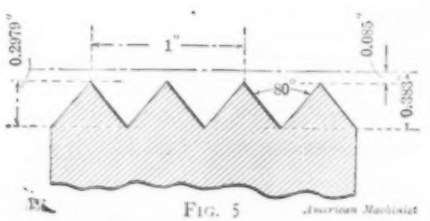


FIG. 5

EXAMPLES OF ERRORS DUE TO USING WRONG THREAD CONSTANT

we would have; cosine of half the angle $\frac{40}{2}$ = 20 degrees = 0.93969.

$$Depth = \frac{0.93969 \times 2}{2 \times 2} = 0.469845 \text{ inch on a side.}$$

The error on each side is 0.68687 — 0.469845 = 0.217025 inch. If we were boring a hole to be threaded to these figures the hole would be too large by twice this error, as shown in Fig. 3.

Taking up the second case; Fig. 4, 60-degree V sharp thread; cotangent of half the angle $\frac{60}{2}$ = 30 degrees = 1.73205.

$$Depth = \frac{1.73205}{2 \times 2} = 0.4330125 \text{ inch on a side.}$$

As stated above, there is no difference in this case, as shown in Fig. 4. Cosine

of half the angle $\frac{60}{2}$ = 30 degrees = 0.866025.

$$Depth = \frac{0.866025 \times 2}{2 \times 2} = 0.4330125 \text{ inch.}$$

Taking up the third case, Fig. 5, 80-degree V sharp thread. Cotangent of half the angle $\frac{80}{2}$ = 40 degrees = 1.19175.

$$Depth = \frac{1.19175}{2 \times 2} = 0.2979375 \text{ inch.}$$

Using the other method, cosine of half the angle $\frac{80}{2}$ = 40 degrees = 0.76604.

$$Depth = \frac{0.76604 \times 2}{2 \times 2} = 0.38302 \text{ inch.}$$

The error on each side is 0.38302 — 0.2979375 = 0.0850825 inch. In this case the hole would be bored too small by twice this error, as shown in Fig. 5.

C. P. MACARTHUR.

Waterbury, Conn.

Fixture for Planing Clutch Teeth

A fixture is shown in Figs. 1 and 2 for planing the teeth of the clutch shown in Figs. 3 and 4. The fixture was made for planing the teeth in but two clutches, so it was essential that it be made as cheaply as possible.

All parts, with the exception of the chuck *D*, former *E*, finger *E'* and gear bracket *H*, were picked up in the shop and had been used for other purposes. Not being able to find a worm and worm wheel suitable for the purpose, I used the miter gears instead, but would have had a more even feed and consequently better results if I had used the former.

This fixture can be used to plane any shape of clutch tooth, provided the former *E* is made to conform to the re-

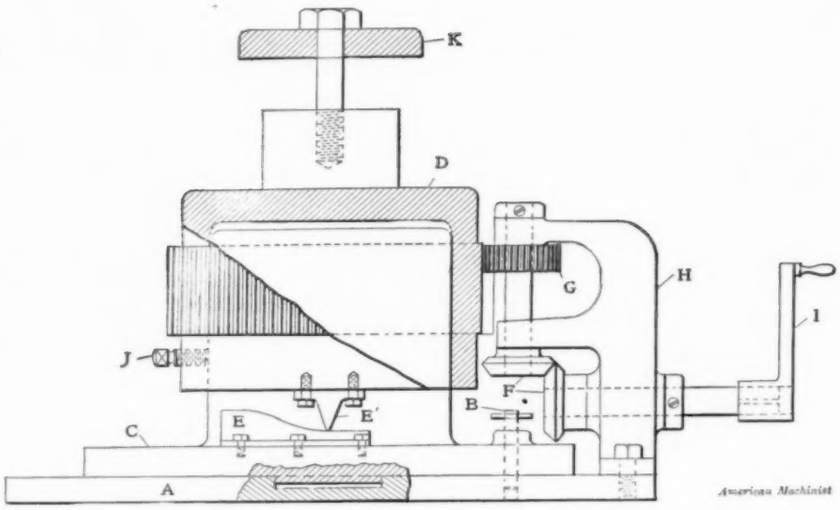


FIG. 2. FIXTURE FOR PLANING CLUTCH TEETH

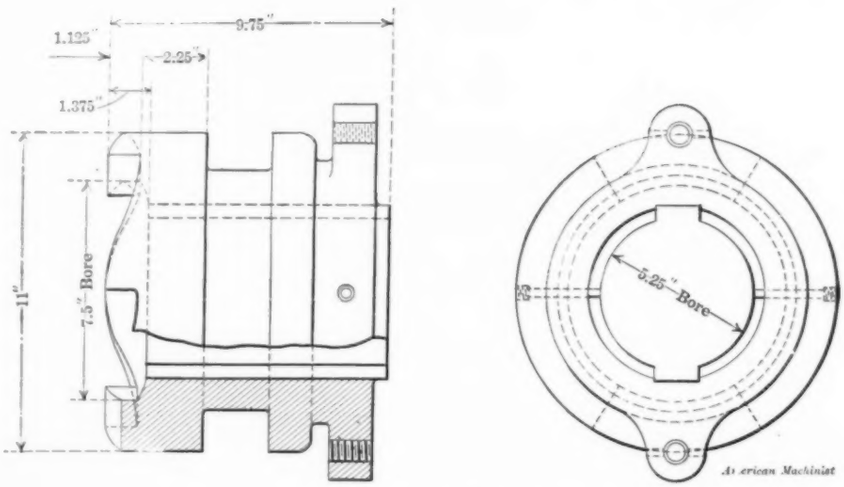


FIG. 3. DETAIL OF STEEL CLUTCH MEMBER

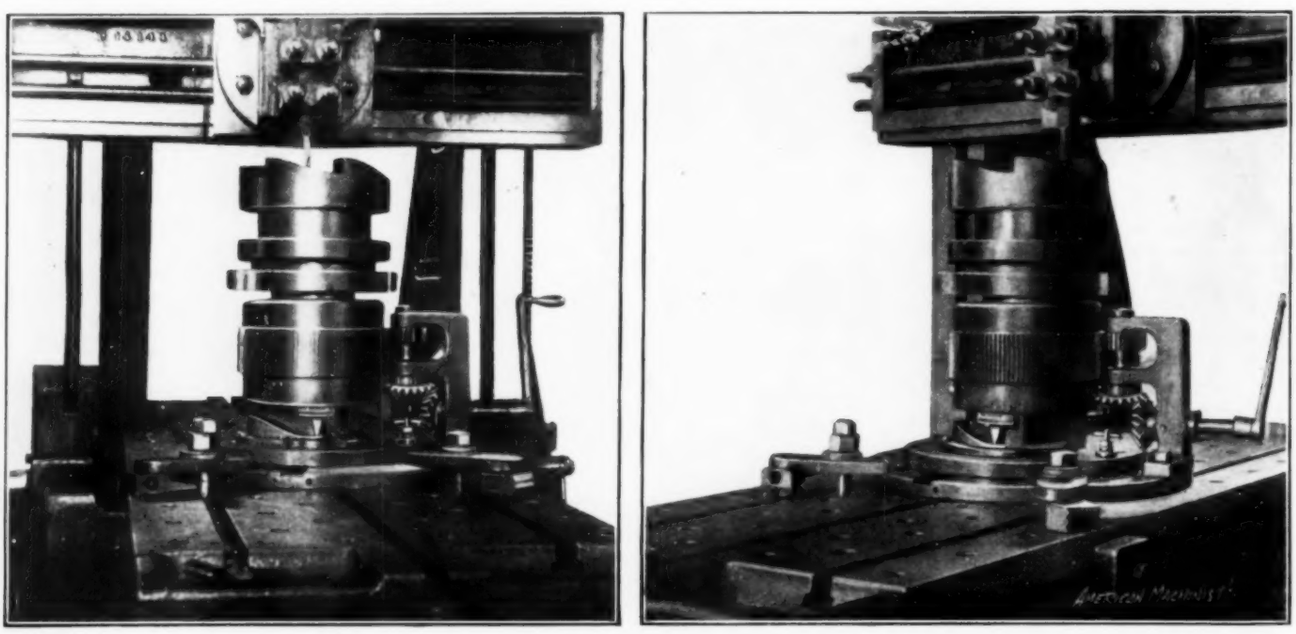


FIG. 1. FIXTURE FOR PLANING CLUTCH

quired shape of tooth. It has since been used to plane other clutches and has established itself as a permanent fixture in the shop.

Referring to Fig. 2, *A* is the index plate which is recessed to receive the hub in base *C* which is a working fit in

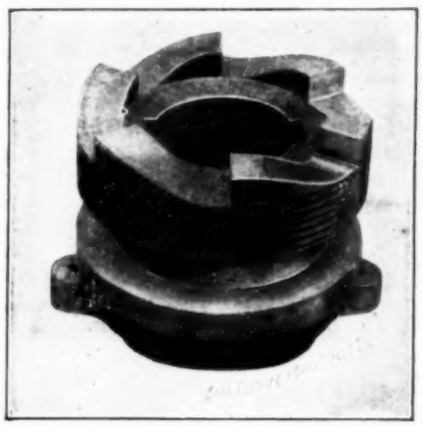


FIG. 4. THE CLUTCH AFTER PLANING THE TEETH

its seat. The clutch having six teeth, the index plate is drilled with six equally spaced holes to receive the index pin *B*, which is held in base *C*. The chuck *D* is a working fit on base *C* and is rotated by means of the spur-gear teeth cut on its circumference, and the pinion *G*, miter gears *F* and crank *I* held in position by the gear bracket *H*, fastened to index plate *A*. The chuck is raised and lowered by means of the former *E* fastened to the base *C*, and the finger *E'* fastened to the chuck *D*. The gear teeth on the circumference are made long enough so that they will always be in mesh with pinion *G* when the chuck *D* is raised to its highest position.

The set screw *J* is used to hold chuck *D* in position while indexing. *K* is a washer to clamp the clutch to the chuck and is about 1 inch smaller in diameter than the counterbore in the clutch, so as to allow clearance for the planer tool.

C. E. CHAMBERLIN.

Bethlehem, Penn.

A Two Spindle Wood Lathe

In the ordinary pattern shop it is often required to do the work of face turning of small pieces.

In such a case we must use the lathe with utmost efficiency especially when the work is in a hurry. To fulfil these requirements in the shop this attachment was designed under my direction. Figs. 1 and 2 show elevation and plan of the wood lathe.

B is the ordinary spindle to which the chuck is screwed, *C* the spur wheel fixed to the spindle *B*, *A* is another spindle placed on the back of the lathe. The spur wheel *D* has a claw clutch and is loose on spindle *A*. *E* is a handle for shifting the clutch *H*.

In using the lathe two workmen can work at the same time, each doing the work independently.

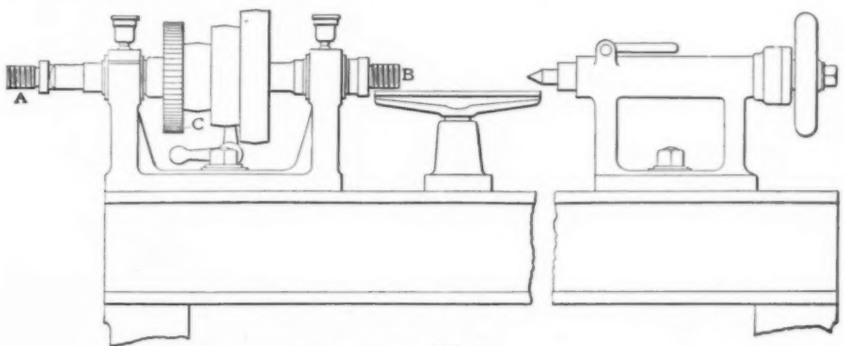


FIG. 1

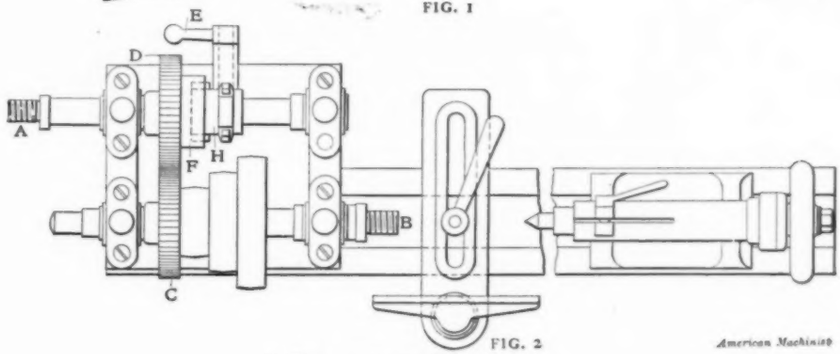


FIG. 2 American Machinist

A TWO-SPINDLE WOOD LATHE

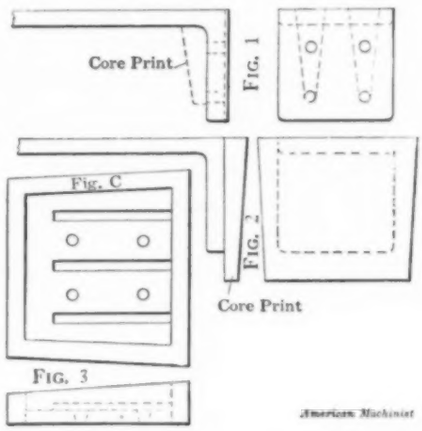
I used this attachment in the shop and found that it worked very satisfactorily and increased the working power of the lathe more than expected.

Tokio, Japan. JAPANESE ENGINEER.

[It would probably be better to have a clutch on the spindle *B* also so that the belt could run continuously and either spindle *A* or *B* be stopped.—ED.]

A Kink in Patternmaking

In coreing for holes or chipping bars, etc., on a foot leg or box pattern, one method that is used considerably is to put



PATTERNMAKING KINKS

heel core prints on the outside or inside, as is shown by the dotted lines in Fig. 1. This always leaves a fin or bad place on the casting that has to be chipped off, or, perhaps, filled up before finishing.

A much better method is to make the core print cover the whole bottom of the foot, as shown in Fig. 2, and then make a core box that takes in all four holes as well as the three chipping strips. By this method one core box is all that is necessary. It makes it easier for the molder to mold the pattern and no fin occurs, therefore, the entire bottom of the foot is left clean and smooth.

Worcester, Mass. FRANK E. JONES.

A Tool Post Wrench

I wonder if any other of the readers of the AMERICAN MACHINIST have seen a

A TOOL-POST WRENCH

tool-post wrench of the order shown in the cut?

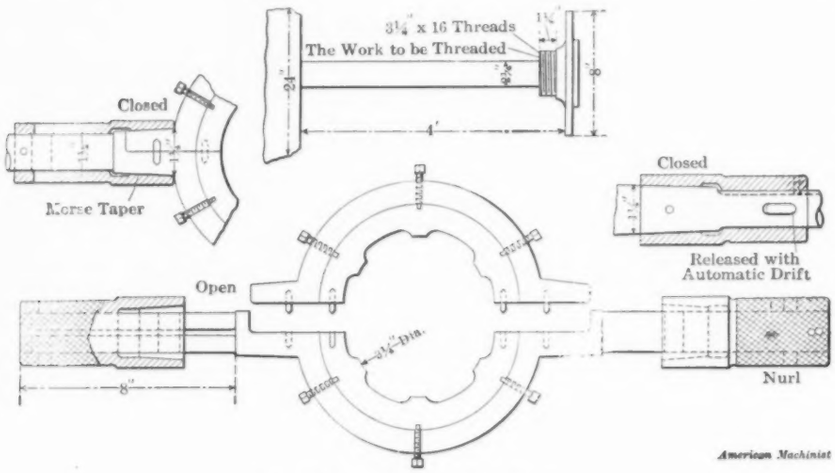
It fits on a square-head binding screw in eight positions, and as more stock is removed by the drill and a plain square broach going twice through has much less to cut it is cheap to make. We fellows in the country think it pretty good.

Syracuse, N. Y. JOHN E. SWEET.

An Opening Die Stock

The sketch shows a practical sizing die which may be useful to some readers that find difficulty of the same sort that I did; namely, to keep the threaded portion of a piece of work to size with a single pointed tool. The job involved was repetition work and several thousand pieces were required every year. I made the device shown, which does perfect work and reduces the cost one-half. Opening and closing the die takes less time than it does to tell the tale.

Kenosha, Wis. OLAF HERSTEDT.



THE WORK AND THE DIE STOCK

A Jig for Testing the Alinement of Connecting Rods

A few years ago a certain machine shop was engaged in the manufacture of a line of single and duplex pumping engines. The average monthly output of the shop ran from 20 to 25 engines of different types and sizes. Not being satisfied with this output and the expense attached to it, the officials made a determined effort to cut down the time and expense of the work.

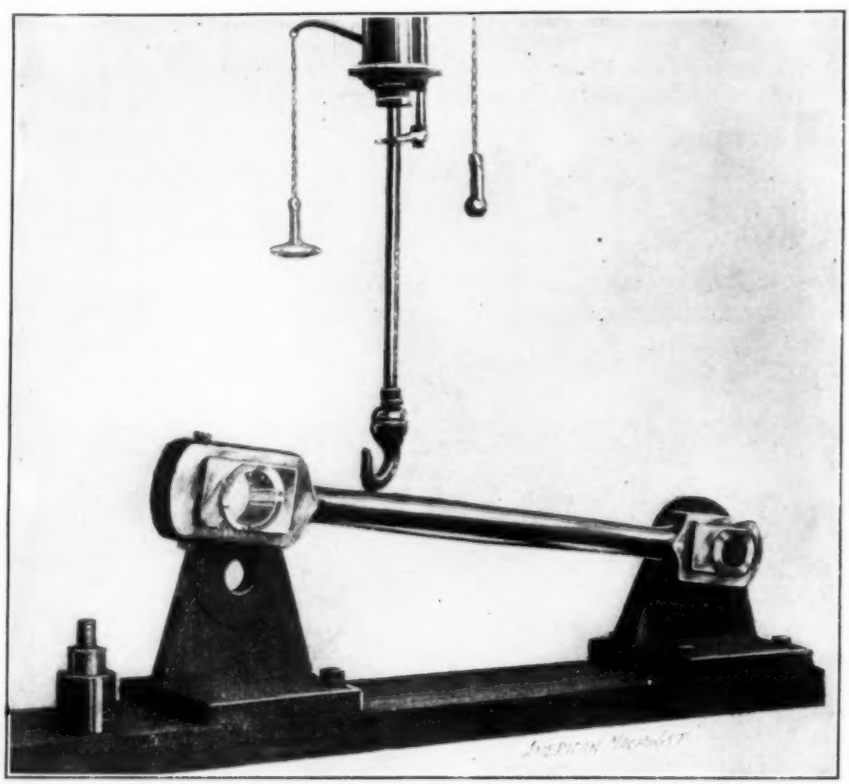
Among the many savings effected I wish to call the reader's attention to the assembling and hanging of connecting rods. It was customary at that time to have a man on the bench assemble the connecting rods and let the erector hang them.

Invariably when placed on the crank pin with the wedge drawn tightly, they would not come perfectly in line, hence it became necessary to scrape them to perfect alinement. This job required the constant services of two men, each receiving $3 a day.

In view of this expense I devised the jig shown in the halftone, which was placed close to the benchman's vise, with a suitable air hoist over it.

The jig consists of a base plate about 1½ inches thick (ribbed on the under side for stiffness) by about 12 inches wide, and long enough to take in the longest rod. The base is finished on top with a groove running the full length. The brackets each have a tongue to fit the groove in the base. The brackets are carefully faced on the sides parallel with the tongue, and at a given distance from it. This is to insure perfect alinement of the face of the brackets. In the center of the face of each bracket a hole is bored to receive the pins which represent the crank and crosshead pins. The pin representing the crosshead is placed in the bracket, the nut securely tightened, and the rod being slipped on the pin and the wedge is drawn up. Next the rod is swung up and down on the pin, removed and scraped until the inner face of the box on the opposite end of the rod comes against the face of the bracket. The pin is then removed from the crosshead bracket and the other pin placed in the crank-pin bracket and so on as before. Should there be any difference between the width of the crosshead and crank pin and of the rod, half the difference is made up by means of a collar on the pin at the narrow end of the rod.

This fixture greatly facilitates not only the hanging of connecting rods, but also serves as a sort of check on the perfect alinement of the contiguous parts of the engine. If there be any difficulty in getting a rod to line up properly after coming from this jig, the erring parts in the engine can be rechecked, the error discovered and corrected; whereas with the old method of hanging connecting rods on an engine these mistakes would never be discovered; the rod would simply be scraped to suit the parts of the engine whether perfect or imperfect.



A JIG FOR TESTING THE ALINEMENT OF CONNECTING RODS

As has been previously stated, it formerly required one man to assemble these rods and two to hang them. When, however, this jig had been a short time in use, the work was conveniently and very satisfactorily done by one man.

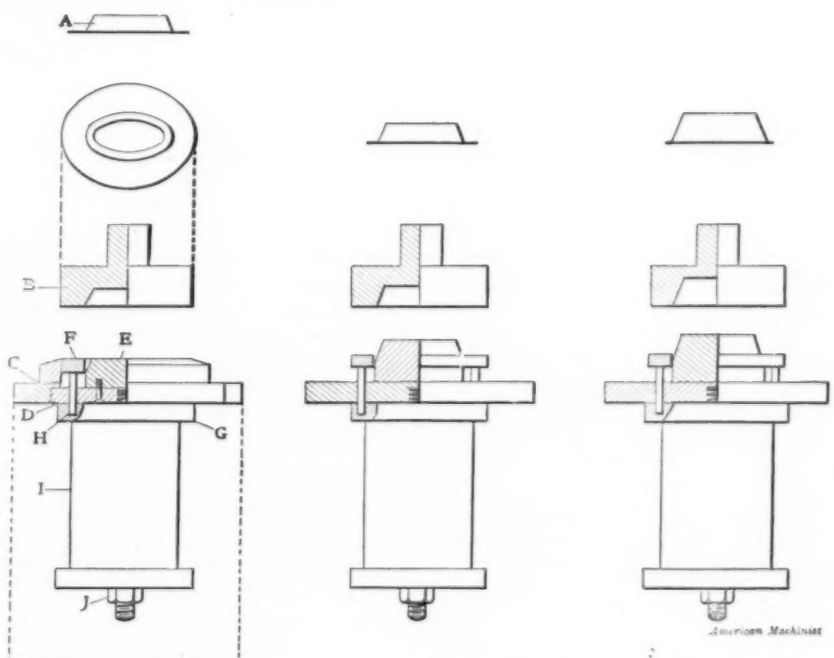
H. W. NALLACE.

Philadelphia, Penn.

Drawing an Oval Tin Receptacle on a Single-acting Punch Press

The tools given in the accompanying cuts were made to produce a small drawn oval disk, the finished dimensions of which were at the top 4¾x3 inches, at the bottom 3⅝x1⅞ inches with a vertical depth of 1⅜ inches. It had straight tapering sides about 20 degrees from the vertical, thus giving the length of the sides of both about 1½ inches. The metal used was ordinary I. G. tinplate, about 30 gage. No drawing press was available so I tackled the job in the following manner: I found by experimenting that it would have to be done in three operations to insure success without breaking the tinplate. The first operation is a combination tool which cuts the blank and forms it to the depth of ¾ inch as at section *A*. *B* is the punch, *C* the cutting or blanking die, *D* the back piece, which screws into the blanking die from the back and to which the plug *E* is attached by the screws, as shown. *F* is the pressure ring, *G* is a cast-iron plate which carries the pressure pins *H*; *I* is an indiarubber buffer and *J* is the adjusting nut for adjusting the pressure.

The action is as follows: The punch descends, cuts out the blank, and as the down stroke is continued, the blank is formed on the plug *E* by the punch *B*. The dimensions in this operation of the mouth of the punch and the outside of plug are a 4¼x2½-inch oval. The second operation is produced by a similar set of tools, but without a cutting die. The plug in this case is allowed to project above the top of the pressure ring to the depth of the first operation, i.e., ¾ inch, and the size of the mouth of the punch and outside of the plug is 4½x2¾ inches, and comes out of this die at a depth of 1 1/16 inches. The third and last operation is done by dies similar in construction to the second-operation dies, the only difference being the plug in this set is allowed to project 1 1/16 inches above the pressure ring, and the mouth of the punch and outside of the plug measure 4¾x3 inches. The size of the blank is 6 1/16x5 3/16 inches, the outside of the flange of the finished piece being 5 9/16x3 11/16 inches, thus leaving only ⅜ inch on each end of the oval and ¾ inch on the side of the oval to draw a depth of 1½ inches.



DRAWING AN OVAL TIN RECEPTACLE ON A SINGLE-ACTING PRESS

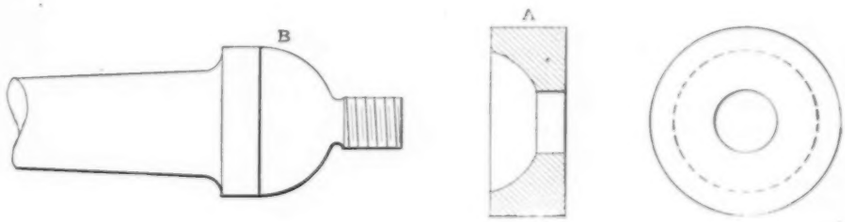
It seems almost impossible to expect the tinplate to stand this draw for such a small article without breaking, but the secret was by making the punches in each set of tools of a different size, viz.; First operation, 4¼x2½ inches; second, 4½x2¾ inches, and third, 4¾x3 inches. About a ⅛-inch round was put on the mouth of the punches and the edges of the plugs in each set of dies. Air holes were, of course, put in the punches and plugs. My impression is that this is a difficult job to do on the single-acting punch press, on account of the shape, small size, depth and being a taper draw. The work came out finished without any creases, only a slight line being visible, where the second- and third-operation punches left it.

Swansea, S. Wales. A. WHITBY.

A Nut Mandrel

The accompanying drawing shows a new design of a nut mandrel, which is simple in construction, and will be found a valuable addition to the tool room.

Mandrel *B* is made of tool steel, and is turned to suit the taper of the spindle of the lathe; the small end of the taper is flattened so it can be used on centers if desired.



A NUT MANDREL

The washer *A* is made of tool steel and is machined to suit the radius on the mandrel *B*. It will swivel on the mandrel to accommodate the nut when the nut is not tapped straight. When one side of the nut has been faced off, the nut is then turned, and the other side is faced off; the parallel face which has been faced off is then screwed against the collar *A* which will swivel to suit that side of the nut.

Washington, D. C. H. D. CHAPMAN.

Speaking of Patents

There is one field of usefulness for the patent that must not be forgot in these days of buncombe. Note!

THE GEARINCTUM MANUFACTURING COMPANY

CAPITAL $1,000,000

Stock on hand	$500
Office furniture	500
Patents	999,000
	$1,000,000

Stock for sale, 1,000,000 shares now selling at $1 per share. Will be raised April 1st to $2 per share.

BUY IT NOW

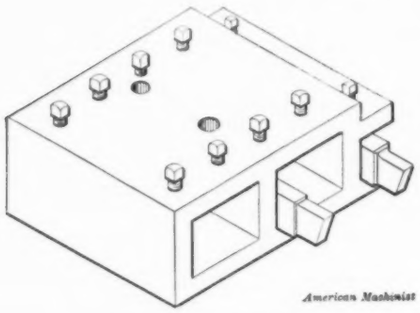
The above advertisement is imaginary as to names and somewhat exaggerated as to details, but it is a good sample of one of the methods of separating a fool from his money. If you offer a patent for sale

as a patent you get the cold shoulder every time, but call it capital stock and it goes.

Lexington, Mass. G. G.

A Combination Tool Holder

The illustration shows a form of tool holder that was recently used in a shop



A Combination Tool Holder

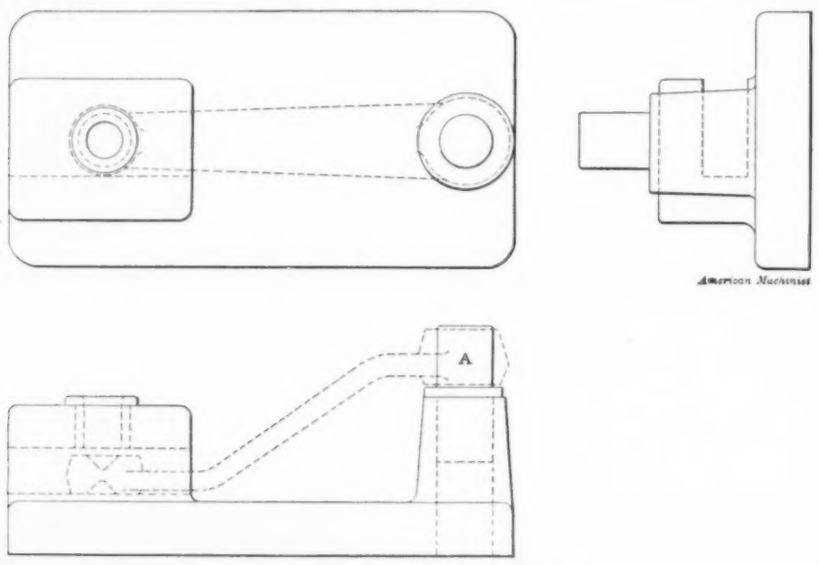
building gasolene engines. It is bolted to the top of the tool block, and five different tools can be held in it at one setting. It was used principally for turning the grooves in pistons to receive the piston ring, two tools being shown in place. It allows of a variety of tool combinations, either for this purpose or for turning shoulders on different diameters of work, or for dividing the cut between a number of tools on heavy turning. It is easily made and may offer a suggestion which can be used to advantage in other lines.

A Drill Jig for Offset Cranks

The cut shows a simple drill jig which we have found to fill the bill for drop-forged levers and arms of different sizes and shapes. The holes in one end are drilled in a previous operation and the sides are straddle milled. The drilled end of the lever goes over the tool-steel pin *A* and the other end is turned under the slot in the casting. We leave clearance of about 1/32 inch under the piece to be drilled at the locating end and about the same or more at the end to be drilled, but above the piece, as can be seen in the illustration.

Charles W. Malpass.

Detroit, Mich.



A Drill Jig for Offset Cranks

A Hardwood Fixture

Where great accuracy is not essential, hardwood, such as boxwood or dogwood, applewood, etc., is in some cases an excellent substitute for metals; they all take a good thread, are easily worked, can be finished in much less time than metal and for many purposes answer equally well.

The line cut shows a milling and drilling fixture for a lathe. It fits in the cross feed block in place of the tool post, and consists of a square block of boxwood with a metal tongue, finished to fit the slot in the cross-feed block, let in at the bottom; a piece of cold-rolled steel, tapped for the two holding bolts; a steel mandrel threaded the same as the lathe mandrel, and clamped to prevent rotating by the two cap screws and iron hand wheel.

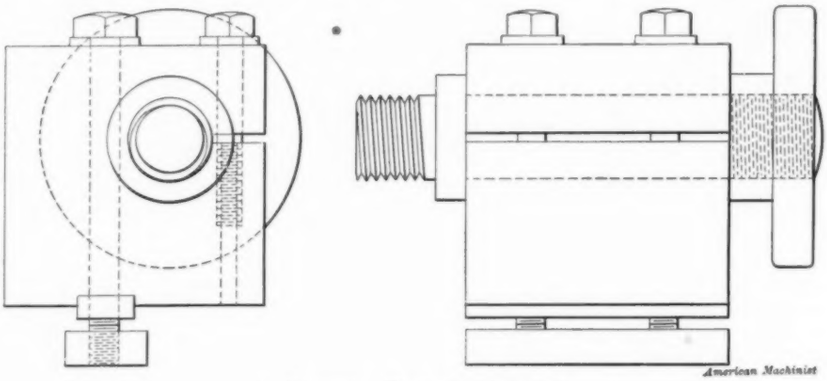
When making it the top and bottom are first faced flat and the tongue fitted; the holes drilled and tapped for the holding bolts and cap screws, and the hole drilled or bored for the mandrel, approximately in the correct position, leaving 1/16 or 1/8 inch for finish. The center of this hole must match the lathe centers.

The fixture is next fastened to the cross-feed block of the lathe, and the hole for the mandrel finished with a cutter and boring bar carried between the lathe centers. It is then removed from the lathe, mounted on a mandrel, both ends faced and the slot sawn.

This little fixture is extremely useful in drilling holes in work held by the lathe chuck. The chuck is carried by the fixture, and the holes are located by revolving the mandrel, and by the cross-feed screw, the drill being held in the lathe chuck.

Light milling can be done by mounting an O.K. tool in a boxwood chuck screwed on the lathe mandrel and used as a fly cutter.

New York. Rolando.



A Boxwood Drilling Fixture

The railway industry is having some important developments in recent months. First Brennan's monorail gyroscopic trial in England brought this new system to public attention and the Scherl monorail development, close upon its heels, has further increased interest in the application of the gyroscope. A model of the latter development has been on exhibit in this city during the past two weeks and has attracted considerable attention in railroad and engineering circles. Another development in the railway field to attract attention during the past few weeks is Thomas A. Edison's long-promised storage battery. From reports of a trial trip made with a car equipped with Mr. Edison's new batteries it proved very successful, and if such is the case it would seem that there is a wide application for this new invention in other fields than that of street-railway utilization.

?DISCUSSION of the PREVIOUS QUESTION?

Letters from our Readers showing how many Men of many Minds look upon Various Subjects Opened up in previous Numbers

Time Saver for Milling Machine Turret

As one who is thoroughly conversant with the motion described by J. H. Johnson at page 958, Volume 32, Part 2, I fear he has not grasped the "cause of the effect" when he says that the intermittent motion is "on account of the difference in the diameters of the respective ratchet wheels." It is not due to this difference, and the diameters have nothing to do with the result.

The intermittent motion is caused by the throw of the crank being something less than the pitch of the teeth in ratchet wheel *C*, and by means of pawl *F* actuated by worm wheel *A* the spindle carrying the mechanism is slowly revolved until the next tooth on ratchet *C* comes within reach of pawl *E*, when the spindle is again quickly moved round.

This motion is not special to the milling machine as the movements to be derived from this combination are very varied. It can be arranged to give a quick advance which is caused by pawl *C*, and this can be followed by a dwell if desired until pawl *F* comes in contact with a tooth on ratchet wheel *B*, and revolves the mechanism slowly until the next tooth on ratchet wheel *C* comes within reach of pawl *E* when the quick movement again takes place.

Therefore, this intermittent movement may be much more varied than was stated in the article above referred to, and is only due to the relative numbers of teeth in the ratchet wheels and the throw of the crank.

S. E. PACEMENT.

Edinburgh, Scotland.

Patternmaker's Varnish Pot

Noticing the article at page 1027, Volume 32, Part 2, I wish to offer an improvement on this kind of a varnish pot. The brushes should not touch the bottom as it will spoil them every time. They should have a hole drilled through the handle and wire pegs should be fastened to the cross bar which is used to wipe off the surplus varnish. The brush when not in use should be hung on one of these pegs so that the extreme end of the brush will come ¼ inch from the bottom of the pot. This will save brushes wonderfully as they will not bend on the end.

Oshkosh, Wis. CHAS. KAUFMANN.

Public Trade Schools

The editorial upon "Public Trade Schools" published on page 1153, Volume 32, Part 2, sets forth such mistaken premises and unwarranted deductions concerning the National Society for the Promotion of Industrial Education and the movement for which it stands, that it would seem unjust both to the society and to the public to let it pass unanswered.

It seems evident that the editorial was written by one who was not present at the convention of the National Society at Milwaukee, and also by one who is not at all conversant with the aims and thought of the so-called "professional educators" in this field.

In the first paragraph the charge is made that "the professional educator is gaining the ascendant in the activities of the association, with the result that the influence of the association is directed more and more exclusively toward the public-school system as the proper channel through which the problem is to be solved, the plan in contemplation involving the organization of a vast system of trade schools supported at public expense."

Nothing could be further from the truth than the statement made in the last clause. The society has never stood for any policy approaching this pronouncement in the past, and most assuredly it does not today. The only expressions in the councils of the society in favor of such a plan have been made by manufacturers and not by schoolmen. The sole policy of the society, and one which has been adhered to steadfastly, is to further a general propaganda in the interest of industrial education and to bring about the discussion of all phases of the problem, to the end that public sentiment may be enlightened and in the course of time the soundest and best-matured methods of approach may be developed.

In furtherance of this policy the society has endeavored at all times to give representation upon its program not only to the manufacturers' general attitude upon industrial education, but to the exposition of those phases of apprenticeship training and corporation schools that have had important development of late years. To the study and exposition of these subjects, together with all other aspects of industrial education, the society will continue to give impartial attention and undiminished effort.

At the Milwaukee meeting, besides the subject of trade schools, the professional sessions dealt with evening schools, State legislation, and intermediate industrial schools for boys and girls from 14 to 16 years of age. Each of these topics received at least as much time and attention as the subject of trade schools.

No tendency toward a propaganda for trade schools developed from this meeting but rather an illuminating opportunity for first-hand study of the limitations and difficulties of such schools, as well as their possibilities.

It would seem to be a matter of regret in a case where facts are so readily ascertainable that a paper of the standard of the AMERICAN MACHINIST should fall so easily into misrepresentation. Particularly is this true in the matter of an organization that has stood so squarely for a broad and impartial policy and for the consideration of all the elements in the problem as has the National Society for the Promotion of Industrial Education.

C. R. RICHARDS.

President, National Society for the Promotion of Industrial Education.

Some misconception may arise to those in this State who read the editorial on "Public Trade Schools." I shall make no attempt to speak from any other standpoint than this State and I shall only take up points which are a matter of public record.

You make the assertion with such confidence that school men and professional educators are the ones who are clamoring for the extension of trades schools and are eager to rush into their direction. We ought to welcome their interest in a more effective educational system, of which trades schools are but a small part of such a system of education. On the other hand, the trades school idea has commonly been the one idea concerning industrial education held by the employer.

In the investigation into methods of industrial training in New York State made by the department of labor, the following questions were put to employers:

"Would practical day trade schools, giving a specialized training of one year or more after the age of 16, help to meet the problem of skilled employees in your business?" To this, 744 employers, representing establishments with 198,865 employees, answered "Yes," 341 employers, representing establishments with 78,194 employees, answered, "No."

In answer to the question, "Could the

last-mentioned schools be advantageously administered by the State or community at public expense and operating on a non-commercial product?" 582 employers answered, "Yes," and 348 answered "No."

To the question "Would such schools if conducted by industrial establishments or a combination of such establishments and operating on a commercial product, be practical?" 405 establishments answered "Yes," and 529 answered "No."

The schoolman has hesitated to take hold of the task of creating and directing the trade school. While standing firm against the control of such schools by influences that would use them for selfish ends, he has recognized the need of supervision by practical men, and the New York State law for industrial education contains the following provision in cases where industrial or trades schools are established: "The Board of Education . . . . . shall appoint an advisory board of five members representing the local trades and industries."

We ought to welcome the counsel and advice of such a board, a board which ought to assure to these schools the best of technical results and should be of material assistance to boards of education and supervisory officers in determining the proper course of study and equipment. Nothing will inspire more confidence on the part of the people in these schools than to feel that these employers and employees are in active coöperation with boards of education, aiming to spend public money economically and efficiently.

Those who advocate industrial and trades schools have more to learn than to fear from contact with practical business affairs. Conversely, those who call themselves practical men, might do well to get in touch with actual school conditions. The fault in the past has been not that the schoolman was jealous of his higher prerogatives, but rather that he was oblivious of the fact that there was anything to be learned from outside sources. The business man and the schoolman have been in the past too far apart. They have considered that there was little common ground. Business men have idiosyncrasies as well as schoolmasters. The business man has looked upon the schoolmaster as a somewhat useful sort of person, but one whose efforts affected business development but little. In turn, the schoolmaster has regarded the business man as one whose opinions were of little consequence so far as pedagogical practice was concerned and as one who did not comprehend or sympathize with the difficulties of school administration. Such a condition of affairs should not exist in the industrial education proposition.

ARTHUR D. DEAN.

Chief, Division of Trades Schools, New York State Education Department.

Patent Interferences

The article on patents, on page 106 of your journal, by L. P. Alford, is more than interesting, and should be brought to the attention of the "powers that be" in hope that it may aid in making such change in the laws and rules of practice as are urgently required.

The experience of Mr. Leonard, however, is just the opposite from that of the average inventor who is not retained by one of the large corporations, and I desire to look at the case from the standpoint of the several inventors who innocently received their patents, and afterward had their claims adopted by others.

In view of the great number of pending applications in most of the leading arts, and the limited time the examiner can give each case, it is really a wonder that more interfering claims do not slip through than do. It is not the interfering claims inadvertently allowed that cause trouble, so much as it is claims that might have been made by the prior applicant had he known as much when he filed his case, as he knew after he had seen the patent issued to the subsequent applicant.

The practice of holding an application before the Office for the express purpose of enlarging its claims to cover later developments by the applicant is bad enough, but where the owner (usually not the inventor) deliberately delays the issue of the patent to see what later applicants may disclose, and with a view of adopting any claims that may possibly be read into the prior application, and thus worrying the owner of the patent by a long, expensive interference contest is in my opinion the greatest evil permitted by our present rules of practice.

I know nothing of the merits of Mr. Leonard's case, and will take it for granted that he had thought of all that was claimed by the later applicants and was, therefore, entitled to such claims; but should he have merely disclosed the rudiments of the invention on which such patents were granted, without knowing what was required to produce the results claimed he had no moral right to enlarge his claims to cover all that such patents might suggest to him.

Eight Illustrative Cases

I have known at least eight instances within recent years where within a year or two after a patent issued, an interference was declared with an older application in which the claims of the patent had been adopted, and in most of these cases the prior applicant had not thought of the features claimed; but as the drawings showed the idea in a more or less crude form, and as the old applications had been filed first, the rules decided in favor of the first applicant unless the later applicant could prove that he reduced the invention to actual practice before the older applicant filed his case; in nearly every instance the old applications had been on file from three to eight years, making a constructive reduction to practice before the later applicants conceived the invention.

In four of the above cases the old applications were owned by corporations who retain the exclusive services of able attorneys to attend to their patent business; one of the other old applications was owned by the patent attorney for a corporation, and another by one of the officials of a corporation.

Holding Back Applications to Extend Life of Patent

It is admittedly the purpose of many corporations to hold back their applications for patents for the purpose of virtually extending the life of the patents, and it is evident that some of them do so for the purpose of enlarging the scope of their claims to cover later inventions by other inventors. Many of the large concerns, both corporate and private, make a practice of making applications for patents on inventions that they have no intention of working, and in many instances for crude inventions that are not adapted for commercial use, and deliberately hold them back for the purpose of roping in subsequent inventors who may have developed the invention and made it of real value.

So pronounced is this line of piracy that it is becoming very difficult for the independent inventor to interest capital to manufacture his inventions until years have elapsed after the issue of his patents, and one cannot be sure the coast is clear of long pending patents even if he wait five years after the allowance of his own patents. I know of an application that has been on file 12 years, and although the owners have never used the invention themselves and have no intention of so doing, they have recently enlarged its claims to cover a mechanical device recently introduced by a competitor.

The public is supposed to be informed of all new inventions within a reasonable time after the applications for patents are filed, and all applications are supposed to result in patents, or be abandoned within a reasonable time, and if patented to become public property in 17 years; but by holding back the issue of the patent it may be kept from the knowledge of the public for 17 years, and then issued for another like term; this has actually been done. Many instances are known where applications have been held back 10 or 15 years, and it is probable that there are hundreds of applications now pending that should have been issued 8 or 10 years ago.

What can be done to remedy this state of affairs?

It seems possible that the legal fraternity who make a specialty of patent practice could influence the desired legislation if they would, but as interferences form a very important part of their practice it is doubtful about help from that source.

The only thing that seems feasible is for every friend of the independent inventor and lover of fair play, who takes any interest in the welfare of our country, to call the attention of his member of Congress to the urgent need of a change in the patent law and rules of practice.

I believe that interferences should be abolished entirely. Grant the patent to the first applicant who is an original inventor, regardless of others who may have been first to conceive the invention, and make the constructive reduction to practice by filing an application proof of invention, over any prior actual reduction to practice, or even public use and sale.

Anything short of this will result in endless delay, perjury, expense and injustice; and it would give all the same chance except perhaps the few who could not pay for an application when they first made the invention. And such inventors could get their friends to assist in such initial cost much easier than they could induce them to help fight an interference.

If interferences are abolished thousands of inventors will apply for patents who now say, "It is no use; I will be cheated out of it the same as So-and-So was," and the Office will have a large force of employees now occupied with interference work, to assist in the regular business.

It is understood that the first to record a deed for real estate, or a claim for the discovery of minerals, holds against others who may have a prior deed, or have discovered the mineral first; and the first applicant for a patent should be treated in the same way.

Another change should be made, and that is to prohibit the enlargement of the claims after the application is filed, other than to amend them to avoid references cited; this to prevent reaching out for the inventions of later applicants.

Patents should run 17 years from the date on which the application was filed, instead of from a date many years later when issued; and except in very unusual cases the patent should issue within one year from the date the application was filed. As there would be no interferences to delay matters, one year would be enough.

With the above changes the inventor could realize on his invention within two years from the date he filed his application, and the manufacturer could after a search of the prior art, arrange to market his goods the next year after the patents were applied for without danger of losing his investment in tools, machinery, etc., and especially without danger of having a long-pending patent issue with claims covering his product after he had gone to the expense of developing a market for it.

Rochester, N. Y. VETERAN.

The GRINDING of HIGH SPEED DRILLS

Three Methods That Are Used Here and Abroad by Many of Our Readers

[The question was asked some months ago of the AMERICAN MACHINIST, "What is the best way to grind drills made of high-speed steel?" Three ways of grinding were suggested: (1) Dry and preheating the drill to about a working temperature; (2) dry at ordinary temperatures; (3) wet, that is, on an ordinary wet grinder.

To cover as wide a field as possible a German correspondent was asked to state his practice, our English editor was asked to review British methods, and several drill makers and drill users in this country were invited to express their opinions.

These opinions follow. The opening of the discussion we have given to our German correspondent, as our German editor is the youngest member of the AMERICAN MACHINIST family. Then follows the article of our English correspondent, and the closing is from our American contributors. Thus the reversal of seniority is complete.

We will welcome continued discussion of this subject, particularly facts based upon experimental investigations.—ED.]

The high efficiency and long cutting life of high-speed steel twist drills as compared with those of ordinary tool steel, have often led to excessive demands upon this tool and to its treatment as if almost indestructible. But it ought not to be forgotten that even here is a limit to endurance.

The long life of the cutting edges of a high-speed steel drill is occasioned not so much by the greater hardness of the material as by the fact that the high-speed steel withstands heat better than ordinary tool steel. Consequently, a twist drill of high-speed steel can, without the least loss of cutting quality, work at temperatures which would suffice to render a drill of cast steel useless.

There exists a certain limit, in going beyond which the cutting edge is annealed, that is to say, softened. In order to prevent this, care must be taken to subject the high-speed steel drills when in use, to effective cooling, say by ample lubrication. Easily combustible oils are naturally unsuited to this purpose, but there must be employed a lubricant which can be used at high temperatures without gassifying.

If, therefore, under some conditions, temperatures arising from friction between drill and work may be high enough to destroy the cutting edges of a high-speed steel drill, how much greater is the danger in grinding! From the foregoing it may be concluded that the final grinding of twist drills, including those of high-speed steel, ought never to be undertaken dry, but always with the use of a powerful stream of water, to prevent the burning or annealing of the cutting edges.

It is especially important also to employ a suitable grinding wheel. The binder ought not to be too hard; a soft wheel is preferable, so that the blunted grains of emery shall drop off at the right time and not break away fragments of the very brittle edge of the drill. The pressure between wheel and drill should, for the same reason, be kept light. It is better to grind toward the edge (therefore away from the back), than inversely to grind from the edge toward the back.

Because of the greater demands which are made of high-speed steel drills, it is self-evident that primary attention must be paid to grinding the edges regularly and at the correct angle. A twist-drill grinding machine constructed for this purpose should, therefore, always be employed. The errors which are caused by free-hand grinding and which result in bad performance by the twist drill, arise either from a point angle that is too large or too small, and which, therefore, forms unfavorable edges, or forms the two cutting edges of the drill being ground unequally long or at different angles. The consequence is, that the drill runs eccentrically, so producing too large a hole, or that all the work is done by one cutting edge, which thus very quickly becomes dull. W. POCKRANDT.

Inquiry was made of 15 British firms, not all, however, being manufacturers. Several declined to give their views on the subject for various reasons, as for instance, because the method they used had been arrived at "only after a con-

siderable amount of experiment and the trying of different wheels, etc.," therefore they did not care to give the information away. One firm wanted first to see the opinions of other manufacturers, so that they could base an answer on the same. This was not a Scottish concern—there are no Scottish twist-drill manufacturers.

The points submitted were as follows: Referring to the grinding of high-speed-steel twist drills, some discussion has arisen as to the best procedure, that is, whether they should be, first, heated to about a working temperature before grinding and ground dry, or second, ground dry at ordinary temperature, or third, ground wet.

Opinions Were Invited

In reply, one Birmingham firm stated, that as regards the first method, the trouble of having to heat the drills is likely to prevent its being generally adopted. All the same, drills thus heated up before grinding will probably not be so liable to sudden local heating and tendency to develop surface cracks would be decreased. The second method is thought to be bad unless very carefully carried out, as there is grave danger of producing surface cracks which lead to failure in the drills. The third method, grinding the drills wet, is considered to be quite the best, as it prevents overheating and consequent cracking and has been found quite satisfactory in the practice of the firm.

Opinions of Drill Makers

Another Birmingham firm states that they had made many experiments and recommend the following: In their works they grind all drills, cylindrically and for sharpening, in a deluge of solution made of Mystic compound and water. This serves two purposes, not only keeping the work cool, but lubricating the cutting edges of the wheel, causing it to last longer than if used dry. By the cylindrical grinding they have obtained the best results with "24L comb. Norton" wheels. For the pointing operation or sharpening they use "46K" wheels. The other method of sharpening, which the firm have found its customers to use with very good results, is a coarse, quick-running sandstone with plenty of water and a small amount of soda. This method is faster than the former for removing large quantities of stock, but the accuracy of the job is reduced. A Manchester firm has no experience of the first method mentioned in the inquiry, but of the other two prefers the latter. A Sheffield firm sends a number of directions as to angles, etc., and suggests that drills should be ground directly as they require it and that a machine should be used if possible, but say nothing whatever about wet or dry grinding.

Another prominent twist-drill maker reviews his experience in these words:

"In regard to grinding high-speed drills on the cylindrical parts, also on the points, we find after about 7 years' experience with all the best known makes of high-speed steel, that a great deal depends on the kind of steel used. Our own experience is that no matter what the price, high-class steel gives the best results if ground wet or dry. In grinding drills of high-speed steel great care must be taken to get a suitable emery wheel, in fact a fool-proof wheel, so that it will not soften, nor yet on the other hand cause water cracks in the drill. We used to have a great deal of trouble on this point, but complaints of this description are now a rarity with ourselves. We do not recommend the dry grinding unless the steel is of a very good quality indeed. Of course, some high-speed drills you can grind dry and cool in water and will not crack; on the other hand nine-tenths of the steel in use will not stand the strain of the above.

"I was called over to the Continent to one of the largest twist-drill manufacturers in the world to try and find out about the cracks that appeared in the drill at all parts, and which they put down to the hardening process, though the steel they had previously used came out all right. After carefully following the manufacturing process through I found out that in no less than four operations they were grinding dry and cooling in water, and in the finish or pointing process water cracks were appearing. After getting suitable wheels for grinding and using water, keeping the drill quite cool, we found out that we got good results. We have seen 11 out of 12 drills break, simply because they have been spoilt in grinding, causing fine flaws hardly discerned with the naked eye. We ourselves now do not have one break in three months, which we attribute to the care taken in hardening and grinding."

Opinions of Drill Users

A Coventry firm of drill users state that they grind high-speed twist drills wet and as wet as possible. The difficulty in grinding a drill quickly is thought to be in avoiding undue heating, which interferes with the previous heat-treatment received by the drill. It is thought to be difficult to heat drills first and grind them while hot, as the cost of grinding would be increased, and the difficulty of maintaining uniform results would be beyond the powers of the ordinary workshop. The firm have tried high-speed drills ground dry, but if the drills were ground quickly, found the results not very good on account of the heat. On the other hand, if the drills were ground sufficiently slowly to avoid heating, the time required puts the method out of the question if much material had to be ground off. A Birmingham motor-car works grinds high-speed steel twist drills wet, never for the present having tried any other method, as this was the one advised by the makers. Finally a Leicester firm considered the first method not practicable, and certainly not necessary for ordinary shop use. Grinding a drill dry at ordinary temperatures is thought to be good enough for drills up to 1¼ inches in diameter, provided there is not a large amount to be ground off. The third method, grinding drills wet, is considered to be the ideal method for all sizes for general shop use.

I. W. Chubb.

[Three American twist-drill makers and one user state their opinions, as expressed in the four following quotations. —Ed.]

"We beg to advise it has been our practice to grind drills on a wet grinder using copious supply of water, and there is no danger of the drills checking if they are properly ground. If the supply of water is limited and the grinding not properly done no doubt this checking would show, but we can see no reason why it should develop if care is used in grinding. You can, therefore, see our experience is all in one direction, and we are, therefore, unable to furnish very much additional light on the subject."

"Replying to your letter would say that from what we know at the present time regarding the grinding of high-speed drills we should say that to grind them dry, not heating much above the working temperature, is decidedly the best practice. This is rather slow, but in our judgment more effective than either of the other two methods. We have not as yet found any method to grind high-speed steel either cylindrical or otherwise with any rapidity as compared with carbon steel.

"We have experimented considerably in the different methods of grinding, using all kinds of cutting compounds, plain water, oil, etc., and we are forced to adhere to dry grinding."

"The information which you have heretofore obtained is exactly according to my idea in the grinding of high-speed steel tools; that is, the wet grinding will put in more cracks than either of the other two ways, the dry grinding comes next and the best way is to warm the tool to about the working temperature and grind on a dry wheel to avoid cracks. This has been our experience in every instance that we have tried it."

"I do not believe we can give you any information on this subject which will either confirm or deny the theory that grinding high-speed drills with a flow of water has a tendency to check the steel. Our experience has not shown that wet grinding is detrimental to the high-speed twist drill; in fact, this is the only method we have used. We believe, however,

that care must be used in the handling of the tools in this as well as other operations."

There appears to be considerable uncertainty among users of the high-speed steels regarding the effect of wet against dry grinding in sharpening the cutting tools made from this steel. That the cutting edges are injured by improper grinding appears to be a fact and is recognized by all steel salesmen and shopmen generally.

When the first twist drills made from the new high-speed steels were placed upon the market, a rather elaborate series of tests to determine the best working conditions for these new drills was carried on at the Worcester Polytechnic Institute, the results being published when completed. The twist drills used in the tests were made from Novo steel and were at first sharpened by grinding them "wet" as it is termed. The working results not being what was expected, the cutting edges were examined and appeared to be dulled not as usually appears by a blunting of the cutting edge but by a scaling or slivering off as if it had been cracked on the direct edge. The cutting edges ground were then examined before being used and to all appearances there were slight cracks in the steel at the surfaces directly adjacent to the cutting edges. Some of the twist drills were then sharpened by grinding dry and gave no appearance of being cracked. These when used retained their sharpness and all trouble with the cutting edges was eliminated.

During the year following these tests of high-speed steel cutting tools for lathe and planer work were furnished in all the student work. A wet emery wheel of the regular type had previously been in use for tool sharpening and the new tools were at first ground on this. The general fact seemed to be that while the new high-speed steel tools were all right for roughing out, they did not retain a cutting edge sufficiently keen for finishing, and carbon-steel tools were resorted to for all finishing cuts on work that was not finished by grinding. Soon after this the O. K. tool-holder sets were installed in our shops as lathe and planer equipments and these were provided with high-speed steel cutting points. As it seemed desirable with these holders that they remain clamped in the tool posts and only the cutting points removed for sharpening, several of the O. S. Walker Globe tool grinders were installed for this purpose and located convenient to the machines. It was soon noted that the cutting tools sharpened by being ground upon these smaller dry wheels could be honed and used for finishing cuts as readily as the carbon-steel tools, and presently all tools of the older tool steel were withdrawn from use. Upon the face of it, the above circumstances would seem to warrant the assumption that wet grinding was bad for high-speed cutting tools and that dry grinding was the proper thing.

Evidence against Wet Grinding

As a further evidence of this, I would say that a machine-tool firm, which is using a large number of drilling machines equipped with high-speed drills and pushing the production to the limit, when approached upon this subject argued a contrary opinion. As all their drills were returned when dulled to the tool room to be sharpened, and as they were using a wet grinding machine for this purpose, this at first seemed to indicate an error in the above conclusions. However, it was decided to interview the foreman of their tool room and he at once said that all their drills showed evidences of cracking at the edges when ground upon the wet grinder. A dry grinder was installed and no further trouble has been reported.

Also a writer on high-speed steel cutting tools notes the fact in an English publication that if such tools are sharpened by wet grinding the cutting edges are filled with minute cracks and crumble when used.

Possible Causes of Injury from Wet Grinding

If wet grinding does injure the cutting edges of high-speed steel tools, what is the cause? Does it occur from the fact that the cutting edges against the grinding wheel are heated to a high temperature, while at the same time the stock directly back of the edge remains cold, this leading to uneven expansion and edge cracks? In the ordinary wet tool grinder, the water is brought into contact with the surface of a rapidly revolving wheel, and when the water reaches the tool being sharpened it is moving so fast that it flies out from contact with the tool edge. Is it true, as some claim, that whoever uses a wet grinder for sharpening edge tools instinctively presses the surface to be ground against the grinding wheel much harder than he would in dry grinding, and for this reason alone the edge is injured?

In conversation with numerous users of these new steels, it has usually been brought out that whenever they were using wet grinders it was because they supposed they needed to, rather than from any investigations made to determine the best methods. Even assuming that wet grinding leaves the cutting edge of the tool in as good a condition as dry grinding does, can it be said that an improved cutting edge results from its use? If not, why use a shower bath. Why do some workmen after grinding their lathe or planer tools upon a wet emery wheel believe that they cut keener if finished by grinding dry upon the surface of a disk grinder?

H. P. Fairfield.

Vibration of Gears and Cutters

By O. S. Bickford

I was much interested in your editorial on, "Vibration as a Factor in Cutting Metal," and it calls to mind the many ear-splitting experiences we have had with chattering milling cutters.

I believe as you do that any and all vibration of cutting tools is fatal to the life of the cutting edge, and while numerous improvements in the design of milling cutt rs such as spiral flutes, staggered teeth, etc., have all been steps in the right direction, I believe the time may come when the general use of spiral or worm gear drives for milling machines will almost entirely eliminate the trouble caused by chatter.

In the milling of a tap thread several inches long, where a very small amount of chatter would cause a great amount of trouble, I have obtained almost perfect results, in part by the use of a spirally fluted cutter, but mainly I believe, by the use of a pair of spiral gears for driving the cutter spindle.

While it may not be that noisy gears and chattering cutters necessarily go together, I firmly believe that wherever it is possible to use either a spiral or worm gear drive, the noise of the gears and chatter of the cutters will be conspicuous by their absence.

At one time I was required to connect up a small motor to drive a threading lathe. On account of wishing to mount the motor on top of the lathe it was decided to connect up by gears instead of a belt. The motor ran at 1800 revolutions and the gears sure did go some. Everything was all right until we started up the lathe when immediately the entire office force came out as one man and ordered the lathe stopped so they could begin thinking again.

The gear train consisted of two pairs of ordinary spur gears, and these we replaced with gears of the same sizes but with teeth cut at an angle of about 30 degrees, and to get rid of the pull of one of these gears on the motor shaft which requires to have a free end play, we mounted this gear on a short shaft in line with the motor shaft and connected the two by means of a disk on each one, these having square teeth engaging them together. With this arrangement the lathe ran as quietly as when driven by a belt.

While there would be many problems to face, in trying to use spiral or worm-gear drives for lathes or milling machines in general, I believe there are many places where ordinary spur gears might be replaced with those of the herring-bone type and the results would be very satisfactory indeed.

Driving Power of Leather Belts

*By W. W. Bird**

The question of the proper size of a leather belt for a given power transmission resolves itself into a question of selecting various factors. These factors have been worked out by experiments, by analytical methods, and in practice. Those who are interested in the development of this work are referred to books and papers on this subject and especially to the *Transactions* of the American Society of Mechanical Engineers. This article will simply deal with the facts established and endeavor to put them into convenient form for use in actual practice.

The horsepower that a belt will transmit depends upon the effective tension and the belt speed. The effective tensions depends upon the difference in the tensions of the two sides, of the belt and on the surface friction, which depends upon the ratio of the tensions and the angle of wrap.

Experiments and practice have shown that a belt of single thickness will stand a stress of 60 pounds per inch of width and give good results, that is, it will only require an occasional taking up and will have a fairly long life. The corresponding values for double and triple belts are 105 and 150 pounds per inch of width provided the pulleys are not too small.

Experiments have shown that on small pulleys the ratio of the tensions should not exceed 2, on medium pulleys 2.5, and on large pulleys 3. The larger the pulley is, the better the contact is, the thinner the belt is, the better the contact is for the same size of pulley. When the pulley diameter in feet is three times the thickness of the belt in inches, or in this proportion, we get equivalent results for different thicknesses of belts. This gives us a method of classifying our pulleys. The belt has to adjust itself in passing over a pulley due to its own thickness. Some adjustment is also necessary on account of the crowning of the pulley. These adjustments account for the different ratios for the various pulley diameters. The effects of the crown and pulley diameters are not usually considered in belt rules, which is a grave mistake. The ratios are for 180 degrees wrap and decrease with less contact.

The creep of the belt depends upon its elasticity and the load, and experiments have shown that this should not exceed 1 per cent. in good practice. In order to keep this creep below 1 per cent., it is necessary to limit the difference of tension per inch of width of single belt to 40 pounds. The corresponding values for double and triple belts are 70 and 100 pounds per inch of width. These figures are based on an average value of 20,000 for the running modulus of elasticity of leather belting.

Table 1 has been prepared on the basis of these limitations and gives a value for F in the equation

$$H.P. = \frac{V \times W}{F} \text{ or } W = \frac{H.P. \times F}{V}$$

in which $H P$ is the horsepower, V the belt velocity in feet per minute, and W the width in inches.

Table 2 gives corrected values for F when the arc of contact or wrap is greater or less than 180 degrees. On large pulleys the creep may exceed 1 per cent. if the wrap is over 180 degrees, as the increased friction gives a greater difference of tensions.

Diameter of pulley.....	Under 8"	8"-36"	Over 3 feet	Under 14"	14"-60"	Over 5 feet	Under 21"	21"-84"	Over 7 feet
Thickness of belt.....	Single	Single	Single	Double	Double	Double	Triple	Triple	Triple
Factor.....	1100	920	830	630	520	470	440	370	330
Difference of tensions.	30	36	40	52.5	63	70	75	90	100
Per cent of creep.....	0.74	0.89	0.99	0.74	0.89	0.99	0.74	0.89	0.99
Ratio of tensions.....	2.00	2.50	3.00	2.00	2.50	3.00	2.00	2.50	3.00
Tension on tight side..	60	60	60	105	105	105	150	150	150

TABLE 1.

220°	210°	200°	190°	180°	170°	160°	150°	140°	130°	120°
980	1010	1040	1070	1100	1140	1180	1220	1270	1330	1400
810	830	860	890	920	950	990	1040	1100	1170	1240
730	750	770	800	830	860	890	930	980	1030	1100
560	570	590	610	630	650	670	700	730	760	800
460	470	840	500	520	540	570	600	630	660	700
420	430	440	450	470	490	510	530	560	590	630
390	400	410	420	440	460	480	500	520	540	560
320	330	340	350	370	390	410	430	450	470	490
290	300	310	320	330	340	360	380	400	420	440

TABLE 2.

To illustrate the use of the tables, we will take the following examples:

How much horsepower will a 4-inch single belt transmit at a speed of 4600 feet per minute passing over a 12-inch pulley? The factor is 920, therefore,

$$\frac{4600 \times 4}{920} = 20 \; H.P.$$

How wide should a belt be in order to transmit 50 horsepower at 2000 feet per minute on a 36-inch pulley?

$$W = \frac{50 \; 830}{2000} = 20.7\text{-}inch \; single \; belt.$$

This gives us a width of single belt which is beyond the usual limit, 8 inches being considered good practice for the maximum width of a single belt.

$$W = \frac{50 \times 520}{2000} = 13\text{-}inch \; double \; belt.$$

How wide should a single belt be in order to transmit 2 horsepower at 600 feet per minute over a 4-inch pulley with 140 degrees wrap?

In this case we take the factor 1100 from Table 1 and in Table 2 find a corrected value for 1100 under 140 degrees of 1270.

$$W = \frac{2 \times 1270}{600} = 4.23\text{-}inch \; single \; belt.$$

How wide a belt is required for 300 horsepower at 2000 feet per minute over a 10-foot pulley?

$$W = \frac{300 \times 470}{2000} = 70.5\text{-}inch \; double \; belt.$$

This is too wide. Good practice calls for a change to triple at 48 inches unless for some special reason a narrower belt is necessary.

$$W = \frac{300 \times 330}{2000} = 49.5\text{-}inch \; triple \; belt.$$

The belt speed is limited by centrifugal force, but below 5000 feet per minute the loss on this account is largely compensated for by the increase of friction due to the decrease in the time element of the contact, caused by the increased velocities.

The results given by these factors are well within working values and the belts will probably transmit 50 per cent. more power than these factors, but at the expense of the life of the belt. A liberal allowance at the beginning means less annoyance, fewer delays in taking up the belts, longer life and less cost for renewals and repairs.

*Director of the department of mechanical engineering, Worcester Polytechnic Institute. Reprinted from *The Journal* of the W. P. I., January, 1910.

A test was recently made in Chicago to demonstrate that occupants of aëroplanes could be communicated with by means of wireless telegraphy. A Wright aëroplane was used and the test was satisfactory.

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American Machinist

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

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Do Workmen Object to Concrete Floors because They Are Hard, or because They Are Cold?

Are concrete floors suitable for machine shops? This question has been frequently discussed, and in various cases decided in about every way possible. Thus we have concrete shops that deserve the name in that both shell and floors are of concrete. In other shops a concrete floor has been used with an overlay of wood. Still other buildings are more mongrel in construction in that the shell is of concrete and the floors of steel or wooden framing, with the usual type of mill floor, a hard pine under floor covered with a maple overlay.

It has been contended that it is impossible to attach machine tools to a concrete floor with any degree of satisfaction. That this contention is at fault is shown by many shops today using concrete floors and attaching their machines thereto without any trouble or difficulty, either at the time of original installation, or at a later date when the machines were moved about or new equipment installed.

With this objection removed there is but one other that is worthy of consideration. It is stated that concrete floors are extremely uncomfortable to the workmen. It is pointed out that in shops having concrete floors you will find the men surreptitiously bringing in boards or boxes, or making wooden gratings, or something of the kind to stand upon; or perhaps they wear two pairs of socks and even rubber shoes or heavy overshoes during working hours. When these facts are pointed out it is usually accompanied by the statement, "A concrete floor is too hard for men to stand upon with comfort."

In other columns of this issue we publish an article dealing with the heating system of the Morse Chain Company at Ithaca, N. Y. This system heats the concrete floors as a means of heating the building. Here the workmen do not make use of boards or anything of the like to stand upon, neither do they wear extra covering for their feet. Apparently the question of discomfort in connection with a concrete machine-shop floor is one of temperature, not hardness. If a concrete floor can be made comfortable to workmen merely by warming it to a proper temperature, the last valid objection against a concrete floor for machine-shop use is done away with.

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST.

Our circulation for January, 1910, *was (American weekly, American monthly, English weekly and German weekly)* 116,750.

February 3..... 39,250
February 10..... 24,000

This paper reaches 39,250 *separate readers each month and* 24,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Single Purpose Machines

The evolution of the single-purpose machine has not been rapid, nor can it be said to have yet reached its highest development, and its advantages are still unrealized by too many shop managers. Nor is it easy to break away from the old idea of having a machine that can be used for almost any kind of work or to draw the line between building and manufacturing, even where the number of parts run up into the thousands. But the failure to do this is costing thousands of dollars in many machine shops today, particularly those in which the demand is so great as to keep the mind on quantity rather than methods.

Grinders with all sorts of attachments are being bought for perfectly plain grinding, universal milling machines are used for manufacturing work that is more suited to the Lincoln type of machine and 57 varieties of feeds and speeds are provided where seven or even less would be ample for the work in hand. This means a higher investment than necessary and very often a lower production than with machines just suited to the work.

Even with a single-purpose machine there is a perfectly natural tendency to give it too wide a range in order to meet as many conditions as possible without change. In most cases the machine could be simplified if only the work it was bought for were considered.

We recently ran across an old axle lathe built at least fifty years ago, that had many points of interest in this respect. There was only one feed and not more than two speeds. The feed was so fast that every new man complained that the lathe would not stand it, and yet no one had ever broken it. This was a single-purpose machine that was simple in every way and that had paid for itself many times over even if it had been idle once in a while instead of being used as a bolt cutter just to keep it going.

While there may not be many places where strictly single-purpose machines are advisable, there is too much of a tendency to go to the other extreme and put in machines where the attachments and unnecessary features represent a large and wasteful expenditure. If you must buy this kind of a machine, and it is

often necessary, it certainly seems better to wait until the extras are needed before buying them.

There will always be a large and legitimate field for machines for general work, larger perhaps than for the single-purpose machine, but for manufacturing in large quantities there is no question as to advantages of a machine designed and built for one specific piece of work. The automobile field presents an excellent opportunity for such machines and we feel sure they will be much more widely adopted than at present.

This will be hastened by making them as simple as possible for each special piece of work to be done.

The Futility of Airship Models

Circulars have just reached us describing the new courses in aëronautics to be given during the next few months at the West Side Y. M. C. A., in New York City. One course is designed for men who are seriously interested in the science, and the other is intended for boys. The one feature that is emphasized in both these courses is the making of models of aëroplanes and the like. In fact, throughout a course which has just ended, similar to the one to be given for men during the next few months, a widely advertised part of the work has been almost weekly contests between aëroplane models.

We have nothing but commendation for the energy and spirit of progress with which the educational directorate of the West Side Y. M. C. A. has taken up the subject of aëronautics. Its members have shown a commendabie zeal in developing these courses, elementary though they are, and in aiding to found a new branch of engineering.

At the same time undue stress has been laid upon the building of models with the thought that they will show the action of a full-sized machine built along similar lines. The application of mechanical principles to such questions as stability and balancing is intricate and disputable; in fact, the relationship between a model and a full-sized machine in regard to such points as sustentation and strength is not as simple as the enthusiastic modelmaker would have us believe.

Models are invariably flown in still air at no very great hight from the ground and for no very great distance. A type which may be successful in still air may be absolutely worthless under conditions met with in actual flight. A glance at the models already exhibited at the Y. M. C. A., and particularly those that have been most successful, shows that the dihedral-angle type predominates. This is unquestionably a still-air type. In fact, it is a positively dangerous type in turbulent air.

This futility of model making was well set forth by our contributor Mr. Krarup on page 103, and little more needs to be said to show the complex relationship between a model and its full-sized machine.

If the designer has a full-sized machine completely developed mentally he may reduce it in size and demonstrate certain features with success; but a reversal of this process is futile.

Trade Marks in Bolivia

In the *Official Gazette* of January 25 is printed the text of a circular issued by the Ministry of Finance and Industry of Bolivia, dealing with the registration of trade marks. It is stated that many merchants and manufacturers are neglecting to register their emblems, etc., and pay the corresponding annual tax. The prefects of the various departments are instructed to publish notices allowing a reasonable time for all to comply with the formality of registration, and in case of failure to comply with the law to proceed to collect the fines prescribed in the trade-mark decree.

A Mistake in Our Postal Article

In an article on the proposed raise of rates we made the statement that we were obliged to stamp New York City mail. *This is true of the monthly issues only*, and not of the weeklies.

We regret the oversight; we have no desire to add to the hysteria caused by the proposed law.

We contend that it is not fair to make fish of one and flesh of another publication.

We want all papers that now enjoy the pound rate to stand or fall together.

If one cent per pound is not enough in the judgment of our National Congress, well and good—raise it.

The county free clause is giving something for nothing and should be abolished. The general newspaper and the engineering newspaper should stand the same before the law and pay as much as any other publication using the second-class rate—and no more.

Suggestions for an Engineers Club House in Boston

On the evening of January 22, 430 engineers of Boston and vicinity attended a banquet at the Hotel Somerset, at which George H. Westinghouse was the guest.

Considerable enthusiasm was developed for a club house in Boston for the engineering and kindred societies. Within a radius of 15 miles of Boston 5000 men are engaged in engineering and allied professions. Thus there are enough to support a modern club house. In this building the various interested societies could have their offices. It was voted to appoint a joint committee to take up the raising of funds and preparing plans for a suitable building.

PERSONALS

Items For This Column Are Solicited

William Lodge, of the Lodge & Shipley Machine Tool Company, is at present sojourning in Cuba, where he expects to remain for a few months.

O. L. Hemming, of Hemming Brothers, New Haven, Conn., will leave in May for the principal cutlery centers in Europe, notably Sheffield, England, and Solingen, Germany.

F. P. Glosh, who has been with the Cleveland Twist Drill Company for several years, has resigned to accept a position in the experimental department of the National-Acme Manufacturing Company, Cleveland, Ohio.

Robert Zust, of the automobile and machine-tool manufacturing firm of Milano, Italy, bearing his name, is in this country for a few weeks during which time he will visit a number of the machine-tool and automobile factories.

E. B. Boye, who has been branch manager of the Chicago office of the Warner & Swasey Company, has succeeded David Hunt, Jr., as sales manager of this company in Cleveland, O. Mr. Hunt has associated himself with the E. M. F Company, Detroit, Mich.

Machinery Club Smoker

The annual smoker of the Machinery Club was held on Saturday, January 29, at 2:30 p.m., and was attended by about 600 members and guests in spite of very disagreeable weather. There were singing, story telling and mind reading, all of which were well done and thoroughly enjoyed.

Annual Convention of Manning, Maxwell & Moore Selling Force

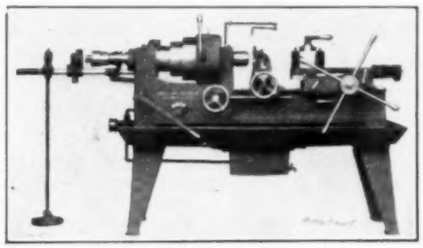
During the week ending February 5, Manning, Maxwell & Moore held their annual convention of the selling force. Two days were given over to the discussion of their business affairs and on Saturday night the convention was brought to a close with a banquet held at the Waldorf Astoria.

NEW TOOLS and MACHINE SHOP APPLIANCES

Showing New Ideas in Machine Shop Equipment that make it possible to do better work at a reduced cost

Turret Screw Machine

The head and bed are cast in one piece and the friction back gearing is entirely inclosed. The spindle bearings are of babbitt metal, spun into their seats. The spindle nose has two blank portions so



TURRET SCREW MACHINE

that the thimble or chuck does not depend on the threads for alinement. It is held very short to bring the tools close to the bearing. The spindle thrust is taken up against the inner rear housing of the head.

The chucking and stock-feeding device is simplified so as to be conveniently handled. The top slide of the turret is provided with six stops depending on and in connection with the turret, being placed in front and on the outside of the top slide and is operated by a cam placed at the bottom of the turret. The stop dog makes about one-quarter of a revolution and by means of an automatic locking plug can be instantly put out of action and clear all six stops. The six stop screws are placed in the segmental-shaped bracket sliding on a dovetail on the bottom slide of the turret. When the stop dog strikes a stop screw it moves the bracket forward to knock off the feed device but allows a slight feed by hand for finishing purposes.

The turret revolves on a stem with means for taking up the wear. A geared power feed of four changes is placed in the rear of the bed and is operated by the little crank shown in front of the headstock.

The cutting-off rest has longitudinal movement on the bed and the cross-feed screw is provided with a graduated dial on the handwheel hub. The tool posts are of a novel design. They are open on the left-hand side to get close to the chuck and the wedges under the tools have a single dovetail at their lower side to keep them in place, and nurled thumb screws adjust them for hight when setting the tools.

Any new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department —the machine-shop news.

A full and detailed description —the device featured—when of special interest and it can appear here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

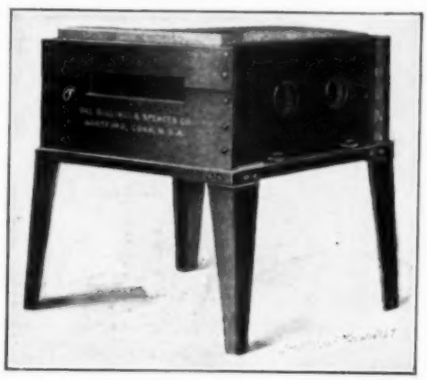
The oil pan is especially deep to receive a large quantity of chips and the tail-end leg is attached in a hinged manner so the machine is supported on the three-point principle. The oil reservoir is hinged to the pan so it can be readily cleaned. The inside is divided into two chambers and all grit and dirt are deposited in the first, separated from the second, from where the pump takes a new supply, by an overflow partition.

This tool is built in three sizes to take 1, 1½ and 2½ inches through the wire-feed arrangement by the Dreses Machine Tool Company, Cincinnati, Ohio.

Heating Furnaces

The Billings & Spencer Company, Hartford, Conn., has brought out a line of heating furnaces for use in connection with the forging of metals, the smaller style being illustrated herewith.

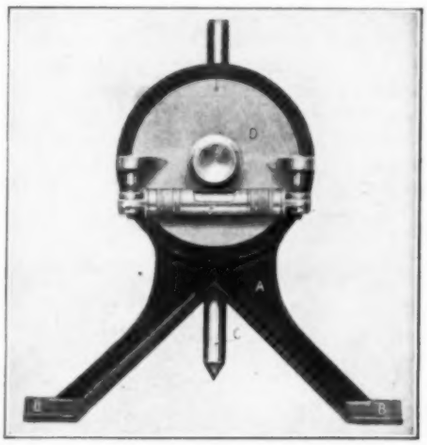
They are built especially for the forge shop, are substantial in every way, and fitted to use either oil or gas.



HEATING FURNACE

Laying Out and Indicating Protractor

This consists of a frame or head having the large 90-degree opening shown in the base *A* and similar openings at right angles to this in the piece *B* for



A LAYING-OUT PROTRACTOR

locating the instrument squarely on curved surfaces in either direction, as well as affording a good bearing on flat surfaces. Running down to the body in a central line with the large and small openings is a substantial scriber or center punch which will scribe or lay off any desired markings on any shaft or other piece of work on which it is placed. In addition to these is the protractor carrying a level so that it becomes easily possible to lay off keyways or other markings at any desired angle from each other. The level is provided with a rotating shield which protects the bulb from injury when not in use.

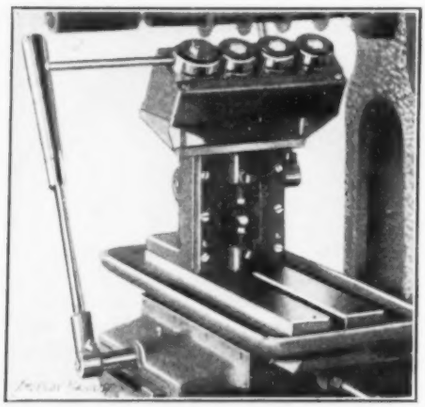
This is particularly useful in leveling shafting and can be applied to either the top or bottom of the shaft as the protractor disk carrying the level can be rotated through the entire circle.

Such an instrument will be found particularly useful in laying out a line of keyways along shafts, either all in line or at specified angles with each other. Where keys are laid out at 90 degrees as in locomotive axles and other work it should prove a time saver. On stationary engine work it presents an easy way of laying out eccentric keyways with a specified angular advance for the eccentric and there are many other uses which will be self evident to the mechanic. This has been patented by W. E. Perkins, vice-president of the Florence Iron Works Company, Florence, Colorado.

Making Castle Nuts

The illustration shows a castle or castellating attachment applied to a No. 3 Garvin hand milling machine for ¾-inch nuts and smaller. It consists of a four-spindle fixture mounted on a vertical attachment. The nuts are dropped into hexagonal hole bushings and fed centrally right into the saws, four at a time, indexed simultaneously by one handle and ejected automatically on the downward motion after the third cut, the nuts being handled but once by the operator. No time is wasted in fixing or mounting the nuts. One hand controls the feeding lever at the back, and the other hand the index handle.

The machine is operated by the regular hand miller levers, making a simple and effective machine of great productive capacity. As nuts are mounted at an angle the drip from the saws falls outside the bushings so there is no trouble from clogging up, and, moreover, the ejectors

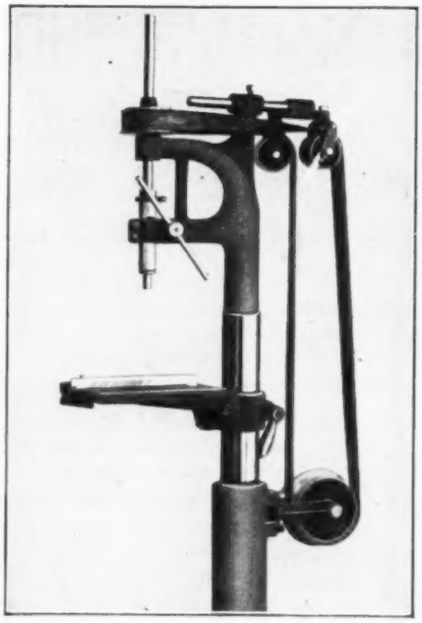


MAKING CASTLE NUTS

fit the hexagonal holes and clear the hole after each nut is ejected. One vertical motion does the sawing, but on completion the table is drawn back by the table lever so that the nuts may be put in free of the saws without danger to the operator. Adjustable stops are provided for the different movements. Four bushings and ejectors are required for each size nut, one set being furnished with the fixture. The attachment is made by the Garvin Machine Company, New York City.

10-inch Sensitive Drill

The illustration shows the latest product of the Rockford Lathe and Drill Company, Rockford, Ill., in the shape of a 10-inch sensitive drill mounted on a floor stand. The spindle is ¾ inch in diameter and 17 inches long with a feed of 3 inches. The table is 8x8 inches, has an adjustable drilling gage for convenience in locating work, and a vertical

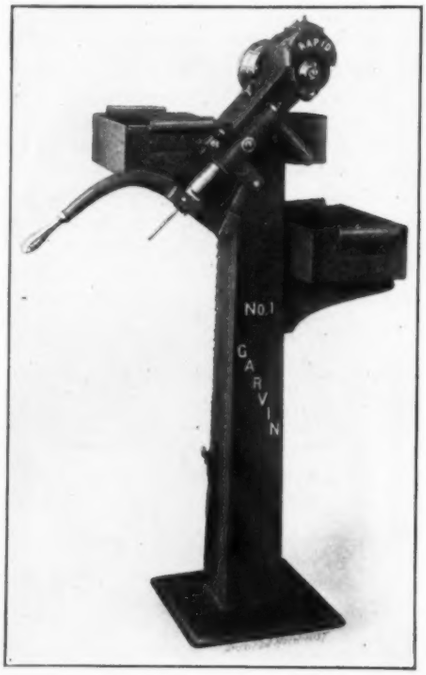


SENSITIVE DRILL

adjustment of 9 inches. The greatest distance between the spindle and the table is 12 inches. A tool pad is mounted on the column.

Rapid Screw Slotting Machine

The illustration shows the "Rapid" screw-slotting machine made by the Garvin Machine Company, New York. This is a simple and convenient tool, light and rapid in operation, which will slot screws from ¼ up to ½ inch in diameter. It carries the screw, which has been entered into a round bush, forward to the saw, with one lever motion, the depth of the cut being regulated by an adjustable stop. The full return of the lever ejects the screw which falls into a sheet-steel box shown at the side of the machine; the oil being carried back into a detachable oil pot above this box.

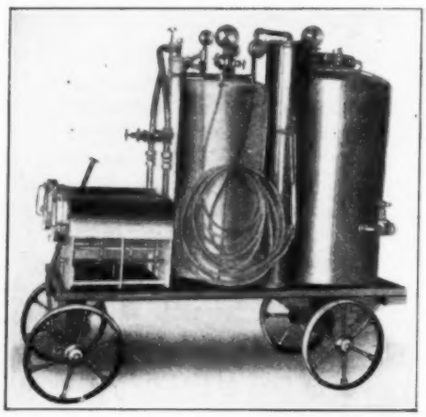


RAPID SCREW SLOTTER

The upper left-hand steel supply box is in a handy position for the operator to get his unslotted screws. The oil supply is contained in the upper part of the main casting and dripped directly onto the saw, which is fully protected. The machine is driven by a tight and loose pulley directly on the spindle. It weighs 150 pounds. A device can also be attached to this machine for the castellating of nuts, ½ inch and below, at a small additional cost.

Portable Welding Apparatus

The important features of this outfit are the economical generation of the gases and their delivery to the blowpipe in a high



PORTABLE WELDING OUTFIT

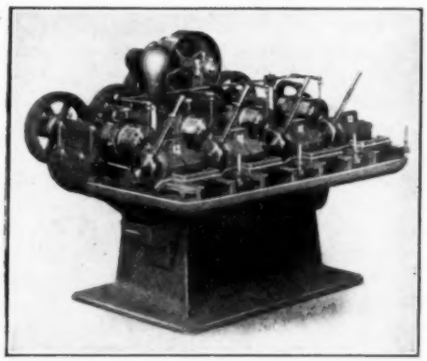
state of purity and at a uniform pressure. The acetylene generator is entirely automatic, requiring no attention when not in use. A regulator adjusts the working pressure as desired, and generation of gas ceases without moving any valves or other part of the machine.

The oxygen generator is arranged for continuous generation, when large quantities of this gas are needed for large work or for cutting metals. The double-gage system has the advantage that by closing the inlet valve to the tank, the movement of the first gage will indicate exhaustion or production in the retort in use. This eliminates all guesswork and unnecessary heating of the retorts. Double purifiers insure a high quality of gas, while special alloy valves retain any oxygen remaining in the tank when not in use.

Reducing valves are used on both gases, which save much time in relighting the torch when the regulators are adjusted to any size tip. The apparatus is made by the Oxy-Carbi Company, New Haven, Conn.

Four Spindle Bolt Cutter

The National Machinery Company, Tiffin, Ohio, has recently brought out a quadruple-spindle bolt cutter which is built in several different sizes. This has a single lever vise and carriage movement which enables the operator to control the forward and backward carriage



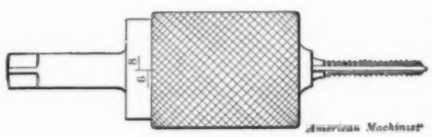
FOUR-HEAD BOLT CUTTER

movement as well as the opening and closing of the vise with a single lever gripped in the left hand, leaving the right hand free for placing work in the vise or removing the threaded work.

The machine has force-feed lubricating pump with adjustable stroke for regulating the flow of lubricant; automatic and hand opening and closing device for each head; and the heads can be run independently or in unison. It is built to run at three speeds. The cone pulley is placed on top of the machine to reduce floor space, and enables the shaft to be supported at both ends and keeps the belt free from grease and chips. The die heads are self-contained and do not depend upon outside mechanism to control the locked position, making the head practically a solid die when closed.

Safety Tapping Chuck

The illustration shows a tapping chuck made by the Woodstock Safety Chuck Company, Woodstock, Ill. This has a



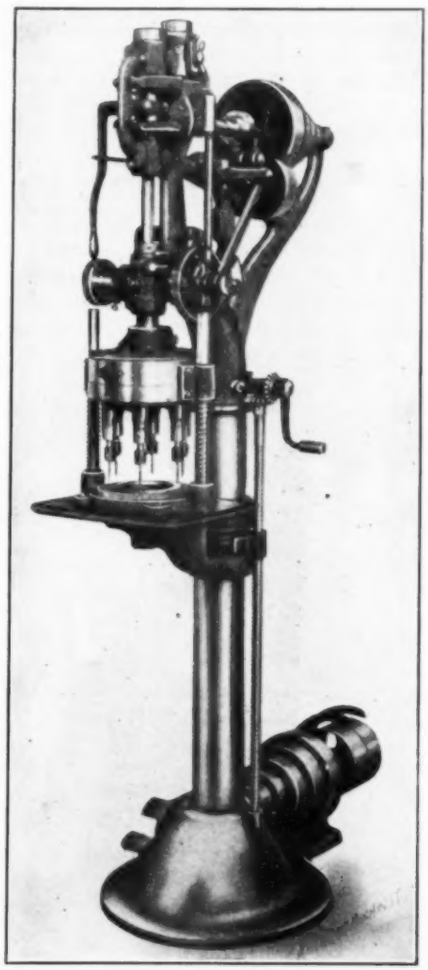
SAFETY TAPPING CHUCK

perfectly round body without projections of any kind and the spring friction clutches for any size tap are secured by simply turning the nurled sleeve until the graduation corresponds with the size of the tap being used. No wrenches of any kind are necessary for adjusting the friction or holding the tap, and it is claimed to give nearly the full strength of the tap while retaining a uniform slipping friction under all conditions, which avoids the breaking of taps.

Upright Drill with Multiple Head

This machine is a 14-inch drill made by the Rockford Drilling Machine Company, Rockford, Ill., equipped with its patented geared tapper and also arranged with power feed. The spindle has an auxiliary head with 6 spindles for use with a drilling jig, which is equipped with a spacer for indexing to each hole.

Taps can also be inserted in the chucks and by the use of the patented geared tapping attachment six holes are tapped at one time. In this way fifty-



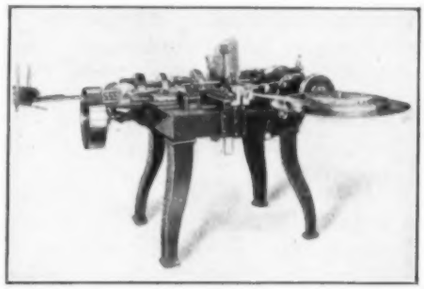
UPRIGHT DRILL

four ⅛-inch holes are tapped in an average of 50 seconds per piece using the next to the lowest speed on the 5-step cone pulley.

The jig is equipped with two guides with coil springs to counterbalance the weight of the auxiliary head so as to aid its quick return on the reversing of the spindle.

A Wire Forming Ferruling Machine

The Baird Machine Company, of Oakville, Conn., designed the machine herewith illustrated for making goods such as suspender loops, buckles, easel stands,



WIRE FORMING AND FERRULING MACHINE

etc. It is a combination of two machines and is entirely automatic in its action, as it will take wire from the coil, straighten, feed, cut off and form it, and take sheet metal from a reel, cut off, form and attach it around the formed wire, the finished pieces dropping into a suitable receptacle at the rate of from 60 to 80 per minute.

Repairs by Autogenous Welding

Two of the everyday uses of welding outfits are shown by the following instances which have come to our notice: A 2-foot piece of brass shafting was recently welded to a 20-foot 3-inch steel shaft for a tow boat which is plying the harbor of Galveston every day, as well as a crack in a cylinder of a 50-horsepower gasolene engine, where the operator had to first cut through water jacket in order to reach the defect.

In a boiler repair, the header for a Hawley down-draft boiler of 500 horsepower was a tube about 8 inches in diameter and ¼ inch thick, which had cracked and been plugged. The plug opened up the crack 3½ inches long, and started another crack about 2 inches long. Waiting for a new header, meant a ten- or fifteen-day shut-down for the factory. A welding outfit made the weld in ten minutes of their master mechanic's time. These were done with Davis-Bournonville outfits.

It is pointed out by the *Mechanical World* that in melting yellow brass chips the waste can be greatly reduced by the use of a suitable flux which will protect the metal from oxidation, as the loss in melting might be caused as much by the oxidation of the metal as by the volatilization of zinc.

Records at the Los Angeles Aviation Meet

By Augustus Post

The first aviation meet to be held in America was a great success. Those who were at Los Angeles do not hesitate to say that it was the most remarkable event ever held in this country. Flight has now been made almost commonplace, as is clearly shown by the fact that passengers were invited to ride through the air on pleasure tours over the country surrounding Los Angeles and that long-distance cross-country flights of almost everyday occurrence caused no undue anxiety.

The most spectacular and notable performance besides the cross-country flights made by Paulhan of 47 miles in 1 hour, 2 minutes 42⅘ seconds to Lucky Baldwin's ranch 23 miles away and return, and his flight with Mme. Paulhan to Redondo Beach and back, was the making of a world's record for altitude on January 12 by his wonderful flight in his Farman biplane, fitted with a Gnome motor, to a hight of 1524 meters, nearly 5000 feet. The conditions were perfect; measurements were made and checked under the direction of Professor Twining and students of the Polytechnic School using a surveyor's transit and computing the altitude by triangulation. These figures, certified by Cortlandt Field Bishop, president of the Aëro Club, of America, were forwarded to the International Aëronautic Federation to be recorded as the world's record for altitude.

Besides Paulhan's great demonstration and exhibition of the possibilities of the aëroplane in the hands of a skilled and daring operator, Glenn H. Curtiss, winner of the Gordon Bennett Aviation Trophy, made records for speed with his Curtiss biplane, flying 10 laps, 16.11 miles, in 23 minutes 43⅗ seconds and one lap, 1.6 miles, in 2.12 seconds and for quick starting, rising in 6⅖ seconds after a run of only 98 feet. Charles K. Hamilton made a very good record, flying with a Curtiss machine: 19.44 miles in 39 minutes ⅖ seconds and reaching an altitude of 530.5 feet, while C. F. Willard, using another Curtiss machine showed his skill in handling an aëroplane by rising from a 10-foot square and landing exactly within it.

The dirigibles of Knabenshue and Beachy made a striking contrast to the speedy aëroplanes and performed some interesting and spectacular feats by carrying aloft Lieutenant Beck, of the United States army, who attempted to drop sand bags intended to represent bombs on to a square marked out on the ground supposed to be the deck of a battleship.

The attendance at the meet was about 187,000 during the ten days, while the gate receipts amounted to nearly $137,500.

Some 14 meets and over $500,000 in prizes await aviators during the year 1910.

Two Novel Attachments for a Drilling Machine

The illustrations show two rather unusual uses for an upright drilling machine, Fig. 1 showing it converted into a thread miller and at work on a good sized worm.

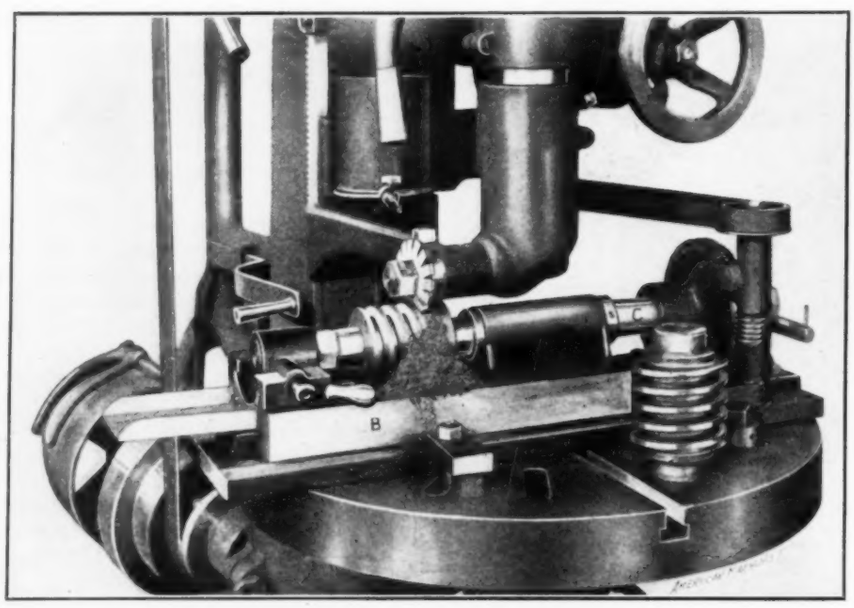


FIG. 1. MILLING THREADS ON A DRILLING MACHINE

This attachment consists of a base *A*, clamped to the table and carrying a slide *B*, on the angular ways, shown at the left of the slide. This slide carries a worm gear at the right end and an adjustable tailstock at the left. The worm gearing at the right is driven by the belt shown and in turn drives a screw which moves the carriage *B* and the work, along the base *A* at the same time it is turning. It is a very simple and effective device and can doubtless be used to advantage in many shops.

Fig. 2 gives another attachment, also worm driven, for milling the pieces of pulleys. It needs practically no description as the entire method of operation is made clear by the illustration. It handles pulleys up to 10 inches on a 24-inch machine and leaves a good surface as well as a crown.

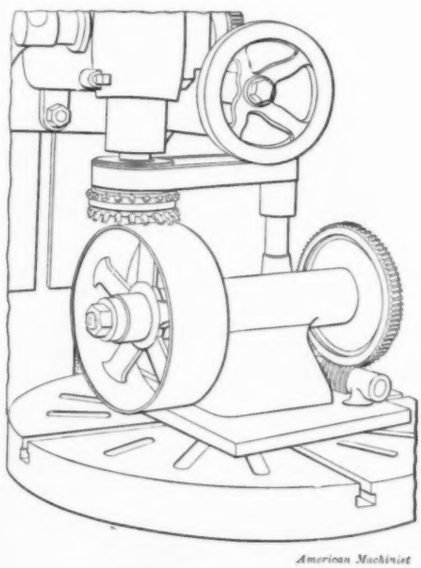


FIG. 2. MILLING PULLEY FACES

Both of these are made by the Mechanics' Machine Company, Rockford, Ill.

Industrial Engineering and the Engineering Digest

A new engineering magazine under the above title, published from 220 Broadway, New York City, makes its appearance with the January issue. This is a consolidation of *Industrial Engineering* and the *Engineering Digest*.

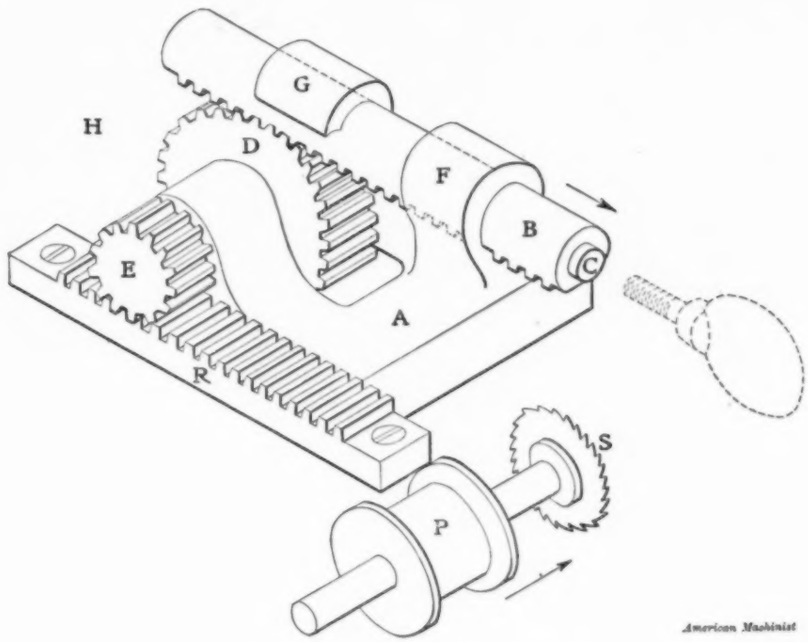
An Interesting Screw Slotting Attachment

An interesting screw-slotting attachment as applied to a five-spindle universal screw machine by Mr. Spencer, of the Universal Screw Machine Company, Hartford, Conn., is illustrated herewith.

An auxiliary carriage *A* is moved along the bed by a special cam, so that the hollow spindle *B* slips over the screw just before it is cut off from the bar. A rack is cut in the under side of *B*, and this meshes in the gear *D*, which is fastened on the same shaft as the gear *E*, which meshes with the stationary rack *R*, fastened to the bed of the machine. It will be readily seen that as the carriage *A* moves back and forth the spindle *B* receives a rapid motion, due to the difference in diameter of the two gears, and a comparatively small movement of *A* gives *B* all that is necessary.

After the screw has been cut off and been carried out of the way by the spindle *B*, the slotting saw *S*, driven by the pulley *P* and substantially supported in bearings not shown, is moved into the position shown by the dotted line to bring it central with the head of the screw to be slotted. Spindle *B* again moves forward to the required distance for the proper depth of the slot and is then rapidly moved back, and after the saw is free from the slot, this also moves out of the way to the side.

The spindle *B* carries an ejector *C*, which projects from the back end in its normal position, but is shown as being in its extreme backward position, so that the end of the ejector comes in contact with the head of the machine, and throws the screw out of the spindle *B*. The whole attachment is very simple, but does its work well and can easily be applied to any of the machines of this make.



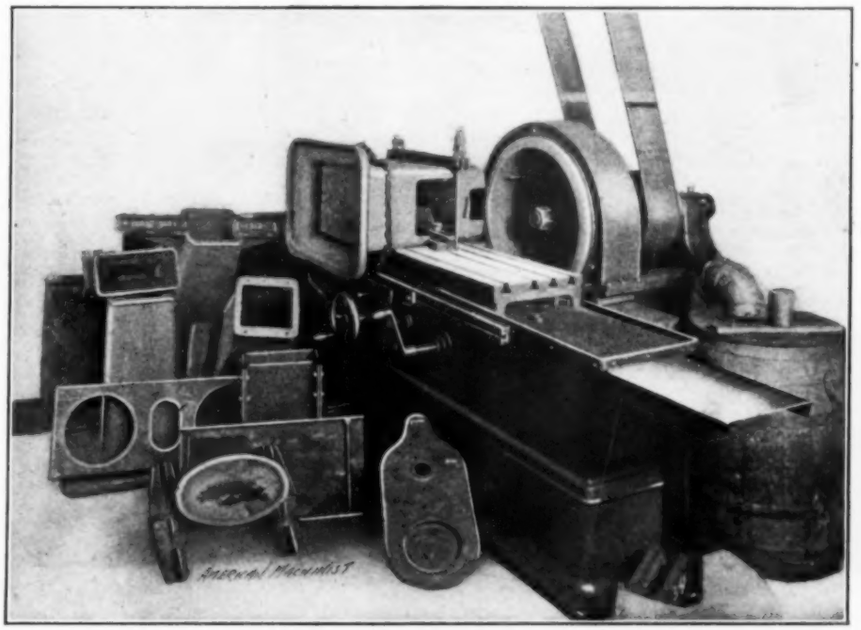
SCREW-SLOTTING ATTACHMENT

Facing Awkward Work on the Grinder

The use of grinding machines for facing work which until a comparatively short time ago was always done on the milling machine or planer, has grown much more rapidly than many mechanics realize, both vertical- and horizontal-spindle machines being used for this purpose. The accompanying illustration shows an 84-inch guide bar grinder made by the Diamond Machine Company, Providence, R. I., squaring off the top of a column for a wet tool grinder made by the same firm. This is an awkward piece to hold for either planing or milling, but is easily held on the machine shown as can be readily seen.

The work grouped in front of the machine gives some idea of the large variety of pieces which are being finished regularly on this machine at considerable reduction in machining cost. These speak for themselves so well that words are almost unnecessary. The use of a large cylinder wheel gives the maximum cutting speed without excessive spindle speed and without too much contact between the wheel and the work.

There are many places where surfacing work can be done to great advantage in this way, which is rapidly becoming a factor in machining methods.



FACING LARGE WORK ON A GRINDER

INCREASING · SHOP · CAPACITIES
where More Tools will be needed

John German will erect a blacksmith shop at Paxton, Neb.

Victor Nelson will erect a blacksmith shop at Geever, S. D.

W. M. Smith, Harlowtown, Mont., will erect a flour mill here.

John Carter, Wood River, Neb., will rebuild mill recently burned.

The Goodrich Rubber Company, Akron, Ohio, will erect a large addition.

The Gladstone (N. D.) Flour Mill was destroyed by fire. Loss, $30,000.

The Northwestern Railroad will erect a roundhouse at Aberdeen, S. D.

The Pacific Foundry Company, Portland, Ore., is erecting a machine shop.

The Northern Paper Mills Company, Green Bay, Wis., will build an addition.

Gordon & Ferguson, St. Paul, Minn., will erect a brick factory at St. Cloud.

Nickey & Sons, Nashville, Tenn., will build a lumber mill in Binghamton, Tenn.

Warren Brothers, Nashville, Tenn., will erect an art glass and paint factory.

The Albion (Mich.) Malleable Iron Company will build a new annealing room.

The Ashland (Wis.) Steam Laundry Company will install additional machinery.

The W. C. Ellis Company, Memphis, Tenn., is in the market for two 14-inch lathes.

The Grabowsky Power Wagon Company, Detroit, Mich., will erect a new factory.

The American Printing Ink Company, Cincinnati, will build a two-story addition.

The N. D. Cass Company, Athol, Mass., will erect a $10,000 addition to its plant.

The Denning Wire Fence Company will erect a large factory at Cedar Rapids, Iowa.

The Penrhyn Slate Company, Middle Granville, N. Y., is erecting a mill at Hydeville.

The Fond du Lac (Wis.) Pressed Brick Company will double the capacity of its plant.

The Toronto (Ont.) Wire Nail and Tack Company will build a new one-story factory.

The plant of the U. S. Radiator and Boiler Company, West Newton, Penn., is to be enlarged.

The Cambria (Wyo.) Fuel Company will install a plant for the manufacture of fire brick.

J. W. Walton, Goliad, Texas, has commenced work on a new machine and repair shop.

The Derby (Conn.) Gas and Electric Light Company will install a turbine and two new boilers.

The Lozier Motor Car Company, of Plattsburg, N. Y., will erect a $1,000,000 plant in Detroit.

Clarkson Lindley, 1426 Hennipen avenue, Minneapolis, Minn., will build a $15,000 garage.

The Ironwear Hosiery Company, Elmira, N. Y., is considering plans for a new $50,000 factory.

The National Box and Binding Company, Sheboygan, Wis., will install additional machinery.

The M. H. Sprague Lumber Company, Washburn, Wis., will build an addition to its sawmill.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Gibson-Whitaker Company, Memphis, Tenn., will build a new sawmill in South Memphis.

The Commonwealth Steel Company, St. Louis, Mo., is building an addition to its foundry.

The canning factory of W. E. Hamilton, at Trafalgar, Ind., was destroyed by fire. Loss, $18,000.

The Guarantee Electric Company, Chicago, Ill., is erecting a new building to cost over $100,000.

The Union Twist Drill Company, Athol, Mass., will soon begin erection of a one-story addition.

M. E. Kenfield will rebuild his box factory at Cass Lake, Minn. New machinery will be installed.

The Dando Printing Company, Philadelphia, Penn., is going to put in a new boiler in the spring.

Fire destroyed the machine and boiler shop of the Shenango Furnace Company, at Sharpsville, Penn.

The city of Grand Rapids, Mich., contemplates spending $20,000 in waterworks improvements.

The Pope Manufacturing Company, Hartford, Conn., will expend $150,000 in improvements.

Willis Owens and others, of Spearfish, S. D., will erect a canning factory at Whitewood, S. D.

The New Milford (Conn.) Electric Light Company will install two new water wheels and engine.

The Thomas Duncan Electric and Manufacturing Company, Lafayette, Ind., will erect a new plant.

The Tallahatchie Lumber Company will build a band mill at Phillip, Miss., of 50,000 feet capacity.

The Adams & Kelley Company will build a $75,000 addition to its planing mill at Omaha, Neb.

The Russell-Miller Milling Company will make extensive alterations at its mill in Bismarck, N. D.

The Bayless Pump and Paper Company will spend $300,000 in enlarging its mill at Austin, Penn.

A new high school will be built in Memphis, Tenn. Mechanical equipment is to cost about $25,000.

The Wolstencroft Felt Manufacturing Company, Frankford, Penn., will build an addition to its factory.

The Dairy Machine Company, Shelton, Conn., will move to Derby where a new plant is being erected.

The Consolidated Fuel and Lumber Company, Marquette, Mich., will erect a hardwood floor mill.

The Helvetia Milk Condensing Company, of Highland, Ill., will erect a $100,000 plant at Mulvane, Kan.

Herman Behr & Co., Brooklyn, N. Y., manufacturing glue, sandpaper, etc., will erect a six-story addition.

The Headley Ice Cream Company, Memphis, Tenn., will establish a $40,000 branch plant at Meridian, Miss.

Remington, Sherman & Co., Philadelphia, Penn., manufacturing safes, are building a new erecting shop.

The Schwarz Wheel Company, Frankford, Penn., will install an uptodate machine shop in the near future.

The Wallace Wilson Hosiery Company, Frankford, Philadelphia, Penn., will build an addition to its plant.

Fire destroyed the machine shop of the Philadelphia (Penn.) Ship Repair Company, at Mifflin street wharf.

B. A. Johnson, Niles, Ohio, is considering the erection of a foundry for the manufacture of brake shoes.

The St. Johns Terminal Company will erect machine shops at Springfield. General offices are at Jacksonville, Fla.

The Marion (Ind.) Stove Company has awarded contract for the erection of a new plant to employ 200 men.

The Loose-Wiles Biscuit Company, Minneapolis, Minn., is contemplating the erection of a new six-story factory.

The Page Manufacturing Company, Cohoes, N. Y., making cotton bats, is having plans prepared for a new factory.

The plant of the Saal-Bloom Company, New Orleans, La., manufacturing tinware, was burned. Loss, about $70,000.

The H. H. Franklin Manufacturing Company, Syracuse, N. Y., will build a large addition to its automobile plant.

The plant of Snow & Petrelli, New Haven, Conn., manufacturers of small hardware, was burned. Loss, about $35,000.

A 325-kilowatt, 3-phase, direct-connected unit will be added to the municipal electric-light plant at Greenwood, Miss.

The plant of the Diamond Flint Glass Works, Montreal, Que., was damaged by fire to the extent of about $30,000.

The Dilver Manufacturing Company, St. Paul, Minn., is about to commence the manufacture of sheet-metal specialties.

The Detroit (Mich.) Copper and Brass Rolling Mills will increase its capital and contemplates extension of its plant.

John Rutherford, Muncie, Ind., is having plans prepared for a factory for the manufacture of gas and electric fixtures.

The Royal Land Company, Des Moines, Ia., has bought the brick and tile plant of Mitchell & Bradshaw, and will enlarge same.

The Carriage Wood Stock Company, Owensboro, Ky., will erect an addition, it is said, for the manufacture of automobiles.

The Hendee Manufacturing Company, Springfield, Mass., manufacturing motor cycles, will erect a five-story addition.

The Western Canada Flour Mill Company, Winnipeg, Manitoba, will spend $250,000 in increasing the capcity of its plant.

The Michigan & Arkansas Lumber Company will build a sawmill at Nettleton, Ark., with a daily capacity of 40,000 feet.

The F. Bissell Company, Toledo, Ohio, manufacturing electrical specialties and machinery, has bought site for a new plant.

The Terry Steam Turbine Company, Hartford, Conn., is doubling the capacity of its plant by the addition of new machinery.

The Fort Pitt Bedding Company, Allegheny, Penn., is building extensive additions and will install complete new electrical equipment.

The Diamond Rubber Company, Akron, Ohio, will build an extension. It is said about $1,000,000 will be spent in improvements.

Fire at the wall-paper plant of the Peckham Manufacturing Company, Newark, N. J., damaged machinery to the amount of $2500.

Sears, Roebuck & Co., Chicago, Ill., are fitting up a building for the manufacture of automobiles at Loomis and Harrison streets.

Plans are being made for a new manual training school at Rockville, Conn., to be known as the Sykes Manual Training School.

The Forrest Estate, 119 South Fourth street, Philadelphia, Penn., is contemplating the installation of two dynamos in the near future.

The Fostoria (Ohio) Independent Incandescent Lamp Company is considering the erection of a factory. H. H. Geary is interested.

The John Deere Plow Company is completing plans for a plant at Saskatoon, Sask., Canada. Construction will begin about March 1.

The Public Service Corporation will build an addition to the Marion Power Station, Jersey City, N. J. Ten new boilers will be installed.

The William Tinkham Company, Harrisville, R. I., woolen manufacturer, has awarded contract for the erection of a new mill to cost $75,000.

The Columbia Motor Car Company, Hartford, Conn., will add new machinery to the value of $50,000.

Fire destroyed the woodworking plant of the Hamilton & Gay Company, St. John, N. B. Loss, $50,000.

The Southern Pacific Railway Company will build three new car shops, also roundhouse at Roseville, Cal. The shops will employ 3000 men.

The Sheridan (Wyo.) Electric Light and Power Company will increase the capacity of its plant this summer by installing a 500-horsepower engine.

The manual training school at Natick, Mass., will install some additional equipment, including a gas engine or electric motor with necessary shafting.

The Talladega (Ala.) Foundry and Machine Company, whose plant recently burned, will rebuild at once and will be in the market for new equipment.

The Marsh-Capron Manufacturing Company, Chicago Heights, Ill., has purchased site on which a plant for the manufacture of concrete mixers will be erected.

The Union Saw Company, which has taken over the business of the Union Saw Company, of Williamsport, Penn., is now erecting a large factory in Frackville, Penn.

The Steel Roof Truss Company, St. Louis, Mo., a new concern, has purchased site at Valley Park, on which a plant for the fabrication of structural steel will be erected.

The Windsor Brick Company, Akron, Ohio, is in the market for a shaper, planer, lathes, drills, emery wheel. New power house has been erected, which is now being equipped.

The plant of the Northwestern Reed & Rattan Company, Minneapolis, Minn., was destroyed by fire. Loss, about $10,000. The company made baby carriages, settees, etc.

The Lebanon Valley Iron and Steel Company, Lebanon, Penn., recently incorporated, will engage in the manufacture of bolts, spikes, etc., for which equipment is needed.

The Chickie Products Company, Newark, N. J., has erected a new factory at Oriental place and Mt. Pleasant avenue. Power plant installed. Is buying candy-making machinery.

The American Steel Foundry Company, of Chicago, will spend $400,000 in enlarging and improving its plant at Granite City. Old shops will be remodeled and new shops erected.

The Ohio Iron and Steel Company, Youngstown, Ohio, increased its capital from $500,000 to $5,000,000 for the purpose of building open-hearth furnaces, and a steel mill at Lowellville.

Fire destroyed the machine shop, sawmill and paint shop at the plant of the Champlain Transportation Company, at Shelburne Harbor. D. A. Loomis, Burlington, Vt., is general manager.

The Norfolk & Western Railroad, Roanoke, Va., is in the market for a lot of new equipment, including machine tools, steam hammers, car-wheel machinery, punching and shearing machinery.

The Van Dyke Motor Company, Detroit, Mich., recently organized with $1,000,000 capital, has had plans prepared for the construction of a plant. Frank G. Van Dyke, 114 Rivard street, is president.

The Minneapolis (Minn.) Bottle and Glass Manufacturing Company, recently formed with $100,000 capital, is said to be planning the erection of a plant. R. Babler, S. A. Hedding and others, are incorporators.

Plans are being prepared by Stearns & Castor, Stephen Girard building, Philadelphia, Penn., for a six-story addition to the plant of the Quaker City Chocolate and Confectionery company, and a four-story velocipede factory for A. Mecky Company.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 28, for boilers, pumps, universal grinder, steam trap, vanadium steel chain, spiral riveted pipe and fittings, valves, etc., as per Circular No. 558.

The Bethlehem Steel Company has prepared a list covering machinery needed for the gun and projectile shop and other departments. It is said $400,000 will be expended. Full information can be had of M. H. Anderson, South Bethlehem.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 21, for locomotive engine oil, valve oil, car oil, stationary engine oil, marine engine oil, air compressor cylinder oil, gas engine oil, black and yellow lubricating grease, as per Circular No. 557.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: February 21—Generating set (schedule 2190), oiling sets (schedule 2192), centrifugal pumps (schedule 2193), machine screws (schedule 2191), taps and dies (schedule 2200), rolled bronze, solder, half and half, billet steel, Class B (schedule 2200), medium steel (schedule 2199).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: February 15—Water meters (schedule 2204), carborundum wheels (schedule 2211), retorts (schedule 2222), bolts and nuts (schedule 2217), twist drills, brass hexagon nuts, band saws, machine screws, wood screws (schedule 2211), rod, sheet brass, galvanized sheet steel, rosin cored solder (schedule 2212).

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids February 21, for engine lathe (schedule 2220), propelling machinery (schedule 2203), air compressor outfits (schedule 2219), oil pumps (schedule 2221); March 1—Electrical equipment for United States steamships "Wyoming" and "Arkansas" (schedule 2218), furnishing and installing freight elevators and hand lift (schedule 2202).

NEW INCORPORATIONS

Simplex Economy Gas Appliance Company, Chicago, Ill. Manufacture gas lamps, stoves, etc. Capital, $100,000. Incorporators, O. F. Reich, J. N. Nagel, etc.

National Electric Specialty Company, Toledo, Ohio. Manufacture lightning arresters, etc. Capital, $50,000. Incorporators, C. A. Atwell, Chas. S. Northup, etc.

Oxford Iron and Steel Company, Oxford, N. J. Manufacture iron and steel. Capital, $125,000. Incorporators, Robert M. Petty, T. A. H. Hay, Sering P. Bowers.

Lumond Motor Car Company, Rutherford, N. J. Manufacture motor cars, automobiles, etc. Capital, $150,000. Incorporators, J. Lumond, Y. Lumond, J. Delmonte.

Merchant Steel and Supply Company, Chicago, Ill. Manufacture and deal in iron, steel, etc. Capital, $100,000. Incorporators, W. K. Kenly, W. T. Tuomey, L. W. Parker.

Gas Engineering Company, Trenton, N. J. Manufacture and install gas machinery, etc. Capital, $100,000. Incorporators, Thomas Watson, Jr., A. Gilbert, Andrew Lovett.

Skowhegan Garage Company, Farmington, Me. Manufacture and deal in motor vehicles and conduct garage. Capital, $10,000. Wm. H. Norton, Skowhegan, Me., president.

Ames Implement and Seed Company, Boston, Mass. Manufacture agricultural implements and supplies. Capital, $100,000. Incorporators, F. B. Hill, R. B. Stanley, etc.

Globe Tubing Company, 227 Grand street, Hoboken, N. J. Manufacture and deal in flexible tubing. Capital, $25,000. Incorporators, G. M. Nicholls, E. A. Van Sothen, New York; Robert Thompson, Jr., Ridgefield, N. J.

BUSINESS ITEMS

The capital stock of the Rockford Lathe and Drill Company, Rockford, Ill., has been increased from $20,000 to $50,000.

The New York Leather Belting Company, 51 Beekman street, New York, has enlarged the size of its belting publication, *Phoenix*, to 9x12 inches. This deals exclusively with belting and transmission problems.

FORTHCOMING MEETINGS

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

American Society of Mechanical Engineers; monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—A few first-class mechanical draftsmen on electrical generators, motors, etc., steady work. Apply, with references, giving experience in detail, stating wages, to Canadian General Electric Co., Peterboro, Canada.

CONNECTICUT

Wanted—Experienced eyelet and die maker; must have thorough knowledge and be able to lay out work; state full particulars, references and wages expected. Box 149, AM. M.

Wanted—Foreman of department in a large New England machine shop; must be a specialist in building machinery by modern methods; this department builds one type of machine only and the acceptable man must be competent to attain maximum results; shop equipment is first class and position permanent to right man; accepted applicant will be required to show his fitness by his past record and replies will be treated confidentially. State salary expected. Box 185, AMERICAN MACHINIST.

ILLINOIS

Wanted—Screw machine and Jones & Lamson operators and toolmakers; good wages, no labor troubles. Velie Motor Vehicle Co., Moline, Ill.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

Wanted—A large agricultural implement factory, continually increasing its engineering force, solicits correspondence with technical men of proven ability, with view toward permanent employment; men familiar with up-to-date manufacturing methods and with several years' practical shop and office experience in the building of factory tools or special machinery, preferred; ample opportunity for advancement for man with initiative. In reply state age, exact experience, technical training, etc. Address Deere & Company, Moline, Ill.

INDIANA

Wanted—Foreman, one who has had experience in building machine tools; a bright future for the right man. Box 146, AM. MA.

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

Wanted—Traveling salesmen mechanically inclined, who visit shops and factories, to consider taking on a line consisting of a device already used in many of our best factories, and will not interfere with any other line. Box 177, AMERICAN MACHINIST.

Wanted—A salesman qualified as mechanical engineer to canvass the larger factories in jobbing centers in the interest of a transmission device already manufactured and sold in large quantities by an old reliable company; state experience, training, salary and references. Box 165, AMERICAN MACHINIST.

MASSACHUSETTS

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—Twenty-five first-class experienced tool and automobile draftsmen; state age, experience, salary wanted, reference, etc. Buick Motor Co., Flint, Mich.

Wanted—First-class foreman for screw machine and turret lathe department, also two first-class men for setting up; state age, experience and reference. Buick Motor Co., Flint, Mich.

We invite applications from first-class machinists and toolmakers, at present particularly Jones & Lamson flat turret operators; we pay good wages to expert men and have no use for any other kind; we also want an inspector for gearing and auto parts. Frost Gear and Machine Co., Jackson, Mich.

Wanted—Foreman for machine shop employing about 50 men manufacturing automobile cranks, transmission gears and various auto parts; must be first class man, experienced in automobile and gear work; give experience, references and salary expected in first letter. Box 62, AMERICAN MACHINIST.

MINNESOTA

Wanted—Several first-class salesmen to introduce and sell our patented speed shifter; will make liberal contract with A-1 men. Address F. L. Lucke, 1728 2nd St., North, Minneapolis, Minn.

Wanted—Tool room man; must be thoroughly familiar with keeping up and pushing production on Jones & Lamson and Gisholt lathes and milling machines; state age, experience and wages wanted; steady employment in growing institution to the right man; none but sober, industrious man need apply; factory product, gasolene traction engines. Address Kinnard-Haines Co., Minneapolis, Minn.

NEW JERSEY

Wanted—Man capable setting speeds and standard times in engine factory; must give full particulars in reference to experience and wages expected. Box 197, AMER. MACHINIST.

Wanted—Toolmakers conversant with fine subpress die work for small duplicate parts; only men of ability on this class of work need answer; factory located within 40 minutes of New York. Box 193, AMER. MACH.

NEW YORK

Wanted—Several first-class jig and fixture draftsmen. Mergenthaler Linotype Co., 29 Ryerson St., Brooklyn, N. Y.

Wanted—Drawing room clerk, one familiar with card system; must be good letterer; middle-aged man preferred. Apply in own handwriting. Box 190, AMER. MACHINIST.

Wanted—Experienced eyelet and die maker; must have thorough knowledge and be able to lay out work; state full particulars, references and wages expected. Box 148, AM. M.

Wanted—Lathe, planer, shaper and all-around floor hands; no labor trouble, good pay, steady work; state experience and wages wanted to start. W. B. Peirce, North Tonawanda, N. Y.

Wanted—Experienced switchboard and mechanical draftsmen; give age, experience and salary wanted. Apply Engineer in Charge, Drafting Department, General Electric Co., Schenectady, N. Y.

Wanted—Lathe hands, planer hands and floor hands; applicants must state by whom employed, past experience, age and wages expected, to receive consideration. Box 42, AMERICAN MACHINIST.

Wanted—Tool or diemakers accustomed to very close and accurate work; first-class men only; good wages; steady position. Apply by mail to Doehler Die Casting Co., Court & Ninth Streets, Brooklyn, N. Y.

Wanted—Thoroughly competent mechanic to take position as speed boss; applicant must give full particulars in reference to experience and wages expected in his first letter. Box 43, AMERICAN MACHINIST.

Wanted—First-class tool designers, accustomed to designing tools for automobile construction; none but first-class men need apply; state salary expected. James Cunningham, Son & Co., Rochester, N. Y.

Wanted—A young man as editorial assistant on a journal of mechanical engineering in New York; technical education and at least two years engineering or editorial experience. "Permanent," AMERICAN MACHINIST.

Wanted—General superintendent for foundry and machine shops; good permanent position with established company for reliable, competent man; state particulars as to age, experience and salary expected. "A. M.," AMERICAN MACHINIST.

Wanted—One mechanical draftsman and one patternmaker at steady employment in good town. Write McEwen Bros., Wellsville, New York, with full experience, references and minimum wages to start and how soon. Machine tool, engine and centrifugal pump experience preferred.

Wanted—A competent production engineer, thoroughly familiar with shop efficiency methods and capable of introducing these methods in a large manufacturing establishment; one familiar with Taylor or Emerson systems preferred; state salary expected. Box 186, AMERICAN MACHINIST.

Wanted—Salesman to sell power transmission appliances in Greater New York; must be qualified to lay out equipments and inspect millwrights' work; man with technical and practical training preferred; state age, experience, present employment and salary expected. Box 189, A, AMERICAN MACHINIST.

Wanted—Man to take charge of small tool and die department in large manufacturing establishment; must be thoroughly familiar with all branches; will also have charge of the up keep of finished stock and tempering; only the best of those so employed at present need apply. Box 127, AMERICAN MACHINIST.

Wanted—Foreman machinist for manufacturing brass shop in western New York, making variety of small and medium sized parts; one who can estimate work from blueprints, design tools, produce goods and handle men to advantage; must be familiar with up-to-date tools and methods. Replying, state age, experience and in what shops, also salary expected; information will be treated confidentially. Box 154, AMERICAN MACHINIST.

Salesman—Exceedingly good opportunity with young progressive manufacturing corporation for bright energetic selling genius (Christian) between 28 and 35, preferably with foundry equipment experience. Right man, after demonstrated ability and loyalty, would be encouraged with interest in business and have most favorable life-long association; must be clean cut, with A-1 habits and references; give age, state fully previous connections, nationality, salary expected, etc. Address Life Chance, AMERICAN MACHINIST.

OHIO

Wanted—One or two first-class diemakers to act as foremen; those having had experience in laying out work given preference; steady employment; good wages. Box 174, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

Wanted—A master mechanic with a good working knowledge of electricity in a manufacturing plant in West Virginia, to take charge under the superintendent of the engine room, machine and carpenter shops, and look after all machinery; the factory is motor driven throughout with 850-horsepower plant; he should be able to handle the job from the start; factory employs about 125 men, 10 or 15 of whom will be under the master mechanic; we are willing to pay a good salary for a steady man about 28 to 35 years old; give details of experience and references. Address Lock Drawer L, Cleveland, Ohio.

MOST POWERFUL TURBINES DESIGNED and BUILT

High Efficiency as a Result of Good Design

BY H. BIRCHARD TAYLOR

The four 18,000-horsepower hydraulic turbines recently installed and tested in the power house of the Great Western Power Company, on the Feather river, at Oroville, Cal., represent the highest development in the art of water-wheel design and construction. There are a number of unusual features in connection with their design and construction which are of interest to the engineering profession at large, as well as to those who are more or less intimately connected with hydraulic engineering.

(1) Each turbine has a greater capacity by several thousand horsepower than any existing turbine in any other installation in this country or in Europe. The highest powered wheels at Niagara Falls are the four 13,500 horsepower turbines designed and built by the I. P. Morris Company, of Philadelphia, Penn., for the Toronto Power Company. Therefore, the Great Western units are each about 33 per cent. greater in capacity than any unit in the great installations at Niagara.

(2) The power is developed in a single wheel or runner. Each 13,500-horsepower unit referred to above is a two-runner turbine, consequently the capacity of each runner is only 6750 horsepower.

(3) The hydraulic head for which the turbines have been designed, namely, 525 feet, is considerably higher than the heads to which it has been customary to apply the reaction type of wheel. It has only been within the last few years that the reaction turbine has been applied to heads much over 300 feet, the impulse wheel having been used almost exclusively for heads above this value.

(4) The guide vanes and wheel vanes have been so designed as to practically eliminate the erosion or pitting of the vane surfaces.

(5) The efficiencies of the turbines, which have been determined by careful tests on all four wheels in place, show conclusively that, from a hydraulic point of view, the wheels are classed among the most efficient in the world.

(6) The turbines complete, with the governing apparatus, are the products of American design and manufacture, and are representative of the highest class of work now being turned out by the engineers of this country along the lines of specially designed apparatus, a branch of the art about which the American engineer knew little or nothing 15 years ago.

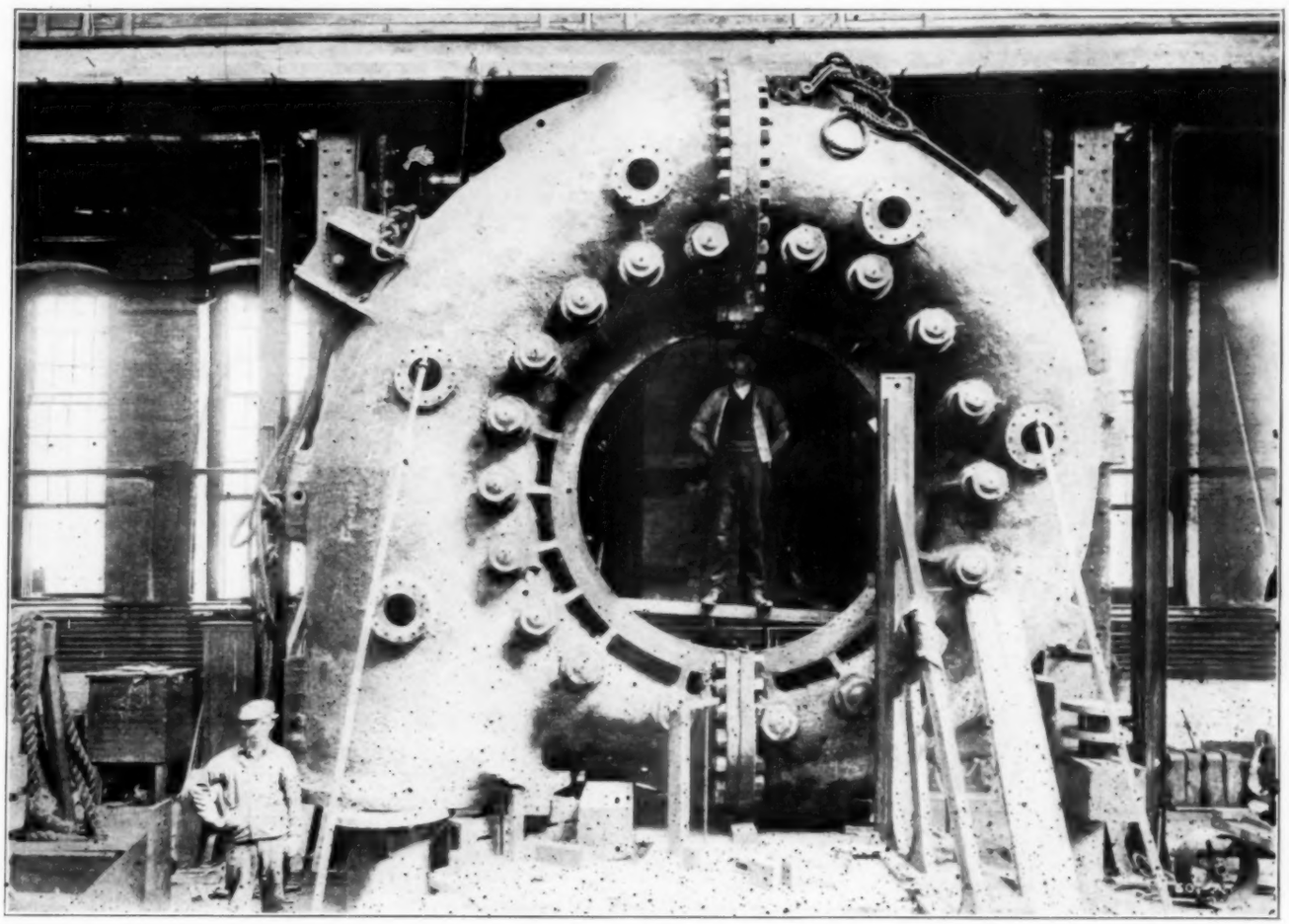


FIG. 1. VOLUTE CASING OF 18,000-HORSEPOWER TURBINE

DESCRIPTION OF TURBINES

The turbines are of the vertical-shaft, single-runner, inward-flow, Francis type, each having a normal capacity to deliver 18,000 mechanical horsepower to the electrical generator which it drives, when operating under a head of 525 feet and

when running at a speed of 400 revolutions per minute.

The turbine units complete, with the governing apparatus, were designed and constructed by the I. P. Morris Company, of Philadelphia, Penn.

The general arrangement of one of the turbines is shown in Fig. 2. The reader may gain an idea of the size of the units by referring to Fig. 1, which shows the cast-steel casing set up on one side in the shops of the I. P. Morris Company.

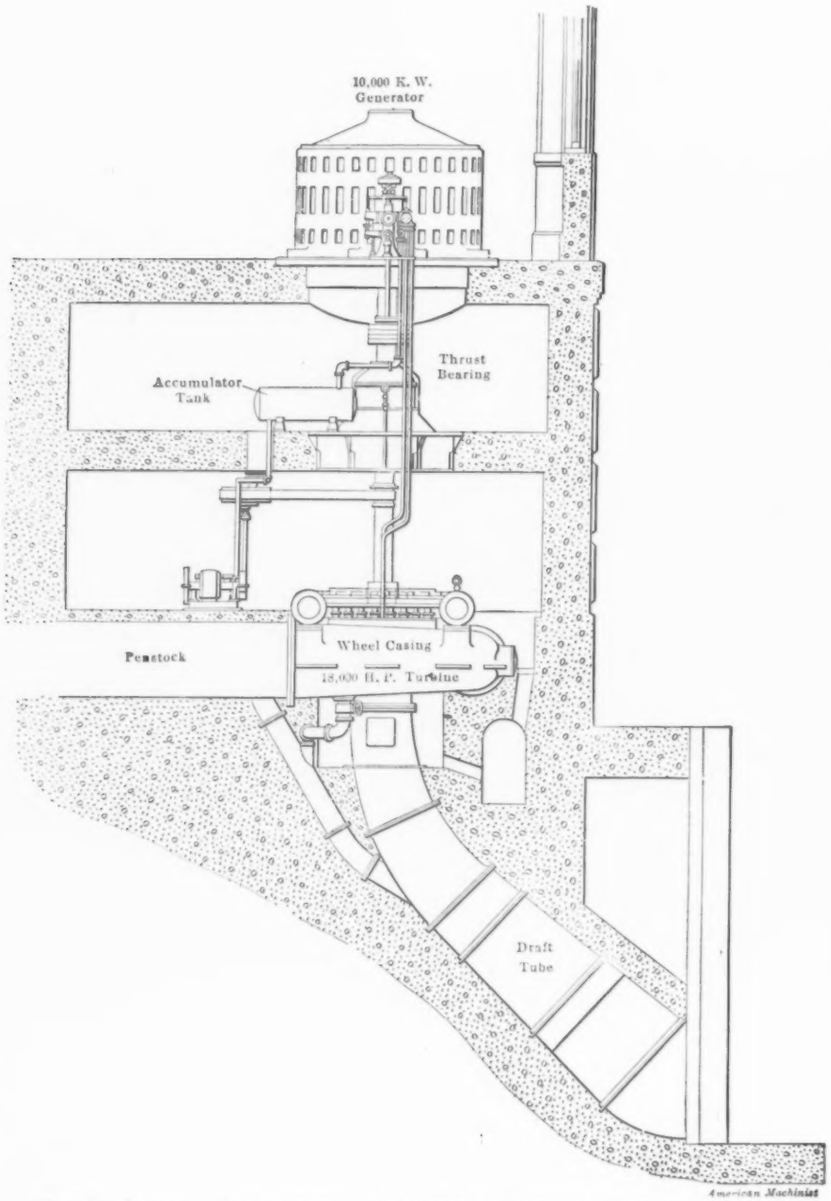


FIG. 2. GENERAL ARRANGEMENT OF 18,000-HORSEPOWER TURBINE OF GREAT WESTERN POWER COMPANY

The runner, which is constructed of special bronze, revolves in a cast-steel volute casing. The water is delivered to the runner through cast-steel movable guide vanes, situated at the throat of the casing around the periphery of the runner. For any particular load on the turbine, the governor will adjust the gates to such a position that the openings between the vanes will admit sufficient water to the runner to enable it to develop the power required to balance that load at the normal speed of 400 revolutions per minute.

Each guide vane has cast with it a long shank on its upper side, which extends through a stuffing box and two bearings to the upper side of the upper head cover, and there it is connected through a lever and a link to the cast-steel operating ring which slides in a groove on the circumference of the head plate. A short shank is cast with each vane on its lower side and this extends into a bearing in the lower head cover. Thus the shank or fulcrum pin of each vane is held rigidly in alinement by three bearings.

The operating ring is connected by two piston rods, which are controlled by two operating cylinders connected in parallel and mounted upon the wheel casing. The cylinders are connected through piping to the main valve of the governor. Lost motion in the operating mechanism is reduced to a minimum by having two pistons controlling the gear from opposite sides of the ring.

The piping between the governor and operating cylinders is made of large diameter, so that the inertia of the oil in the piping between the governor and the cylinders may be overcome in a very small increment of time for all movements required by the gates. Thus the whole operating mechanism is made extremely sensitive and the guide vanes will begin to move before the speed of the turbine has varied more than ½ per cent. from normal.

The normal pressure of the water in the wheel casing is about 220 pounds per square inch, corresponding to the total head on the turbine less the draft head. Each casing was subjected to a pressure of 400 pounds per square inch, in the shops of the I. P. Morris Company before delivery, and all parts of the apparatus subject to this pressure have been designed to withstand it, on a basis of keeping the stresses in the various materials considerably below their respective elastic limits.

Fig. 3 shows one of the turbines partially erected in the shops. By referring to it the reader will understand the arrangement of the operating gear just described. It was while in this position that the hydraulic test was made on the wheel casing. Suitable headers were bolted to the openings in the casing to make it water-tight during the test.

The turbine section of the vertical forged-steel shaft, which connects the runner of the turbine to the rotor of the electrical generator, revolves in two babbitt-lined oil-guide bearings. One bearing is situated directly above the runner and is incorporated in the head cover. About midway between this bearing and the electrical generator is located the other guide bearing. Directly above this bearing is located the oil-thrust bearing, which carries the weight of the revolving parts of both the turbine and the rotor of the generator, amounting in all to about 145,000 pounds.

In addition to this load, the thrust bearing is capable of taking care of a considerable extra load. The downward hydraulic thrust of the runner, caused by the pressure of the water in the chamber between the upper side of the runner and the head cover, is eliminated by connecting this chamber to the draft tube by piping of large diameter.

The thrust bearing consists of an upper and a lower disk; the former is connected to and revolves with the shaft, and the latter is stationary and is supported on the foundations. Between the two disks is an annular chamber into

which oil is forced at a pressure of 250 pounds per square inch, and the resulting upward thrust is capable of supporting the entire load on the bearing. The oil is supplied to the bearing by a horizontal triplex pump, operated through a belt and gearing by the main turbine shaft.

The oil which is supplied to the governor is delivered from a similar pump, driven by a direct-current motor. The oil on its way to the governor passes through a plate-steel accumulator tank, the function of which is to deliver the oil to the governor at a uniform pressure. The oil occupies about one-quarter of the cubical capacity of the tank and the remainder is filled with air under a pressure of 250 pounds per square inch. An automatic regulator in the piping between the tank and the governor keeps these conditions constant. When the turbine is operating at constant load and at normal speed, the pressure on both sides of the regulator is the same and the oil from the pump is discharged through a relief valve into the storage tank.

The thrust-bearing pump and the governor pump draw their oil from a large plate-steel storage tank, which is common to both. It has a capacity of 100 cubic feet and is located beneath the floor. Before the oil from both systems is returned to the storage tank, it is cooled by passing over coils of wrought-iron pipe through which water passes.

In order to keep the oil free from scale and impurities, brass piping is used in both the thrust-bearing and the governor systems. The governor is located alongside the generator on the generator floor, which is about 28 feet above the turbine floor.

Should for any reason the governor be out of commission, the gates of the turbine may be operated by hand by means of a small hand mechanism located above one of the operating cylinders (see Fig. 3). The operating gear is so arranged that should the governor oil system fail, the gates may be controlled by hydraulic pressure, in which case water is admitted from the wheel casing into the cylinder which is arranged for hand control.

Each of the various parts that go to make up the complete unit has been made the object of the most careful investigation—the wheel casing, the guide vanes, the runner and the draft tube—with the idea of increasing the efficiency of the unit as a whole by perfecting the various parts of which it is composed. The results obtained in the efficiency tests of these wheels have amply repaid the designers for their painstaking care in their efforts to turn out the highest class of work.

The first unit was put in operation in December, 1908, and up to the present time the vane surfaces have shown no signs of erosion. The elimination of erosion, through the proper design of the vanes, removes the only barrier to the adoption of the reaction turbine to the very high heads which, up to the present time, were considered exclusively within the field of the impulse type of wheel. Erosion is due to faulty design, and not to the high head under which a turbine operates. Of course, the danger of erosion developing is greater for high heads than for low heads. The writer is familiar with a case where the vanes of runners have been eaten through after operating for only a few months under a head of 40 feet, while in another case runners have been in operation for six years under a head of 266 feet without showing any signs of erosion.

High efficiency is not always an indication that erosion will not develop, but on the other hand, if a wheel has low efficiency when the conditions of power, head and speed are favorable to high efficiency, we know that the water is not passing through the turbine as it should and the causes of the erosion are consequently aggravated.

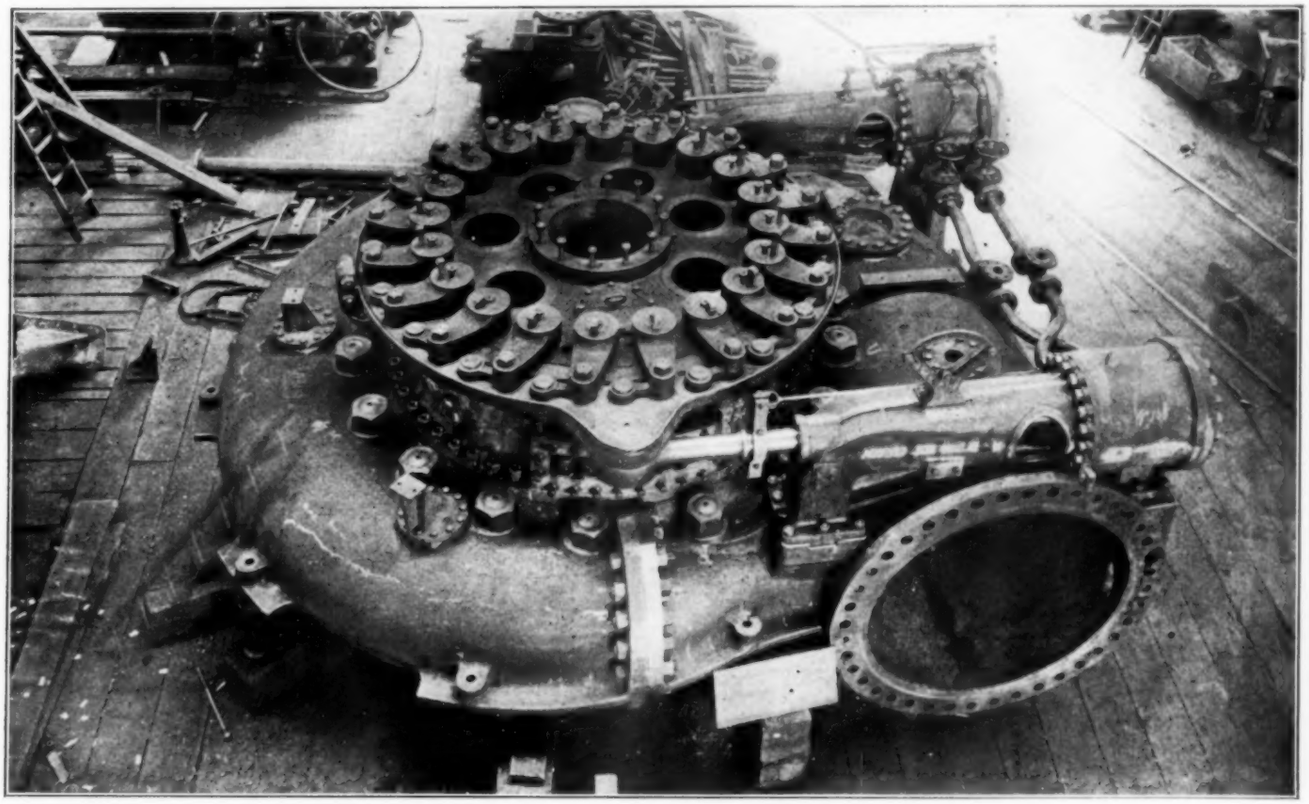


FIG. 3. 18,000-HORSEPOWER TURBINE PARTIALLY ERECTED IN SHOP OF I. P. MORRIS COMPANY, PHILADELPHIA, PENN.

THE EFFICIENCY TEST

Each of the four turbines was carefully tested for efficiency. The volume of water delivered to each turbine, under various conditions of load, was determined by taking traverse with Pitot tubes in the penstock. The position selected for the traverses was at the end of a long straight section at the rear of the power house, so as to insure that the lines of flow in the penstock were parallel to its axis and, therefore, not distorted by whirls in the water caused by bends in

the upper sections of the penstock. The plane in which the traverses were taken was one at right angles to the axis of the penstock, and, therefore, normal to the lines of flow. The plane was divided up into a number of imaginary concentric rings of equal area.

A traverse by the Pitot tube consisted in taking two readings of the velocity for each ring. All the points in one traverse fell on a selected diameter of the penstock, called the traverse diameter. An imaginary circle divided each ring into two smaller rings of equal area, and the two readings for each large concentric ring were taken at the two points where this circle intersects the traverse diameter mentioned above.

A traverse would be made with one tube on the vertical diameter, and then a traverse would be made with another tube on the horizontal diameter. A reading consisted in making one vertical and one horizontal traverse. A number of readings were taken for each setting of the gate.

The point of each Pitot tube was always kept normal to the direction of flow; therefore, the tube read the velocity head plus the pressure head for each position on the traverse diameter.

The pressure head was determined by taking the average of the readings of eight piezometer tubes, which were connected to eight equidistant points on the circumference of the penstock and at the intersection of the traverse plane with the penstock. As the planes of the openings of these tubes were parallel to the lines of flow, the readings obtained were pressure readings only.

The difference between the reading on the glass on the gage board connected to the Pitot tube and the average reading of the eight glasses connected to the piezometer openings on the penstock, gave the velocity head. Therefore, the velocity head corresponding to the velocity in the water at each position of the Pitot tube on the traverse diameter was readily obtained. Knowing the velocity head, the average velocity corresponding to each concentric ring was obtained by the use of the well known formula

$$V = \sqrt{2gh}.$$

In this manner the average velocity in each concentric ring was determined, and by multiplying the velocity by the area of the concentric circle to which it applies, and repeating this calculation for each concentric ring and summing them up by integration, the total quantity of water passing through the penstock, in cubic feet per second, was readily determined.

The Pitot tubes were carefully calibrated by checking them against a weir at Niagara Falls.

The head on each wheel was determined in the following manner: A pipe was connected to the wheel casing and led up the hill to the elevation of the head water, where it terminated in a glass tube on a vertical gage board. The head was taken as the difference in elevation between the reading on the gage board and the level of the water in the tailrace. To this amount was added the velocity head in the penstock where it joins the wheel casing.

The output from each unit was determined by using the generator as a brake. The efficiency of the generator for various loads was carefully determined at the works of the General Electric Company. The electrical output from the generators during the test was determined by taking the average readings of two sets of carefully calibrated instruments, one set furnished by the Electrical Testing Laboratories, of New York, and the other by the General Electric Standardization Laboratory in San Francisco.

During the test, the load on the generator was furnished by a water rheostat having a capacity of from 1000 kilowatts to over 10,000 kilowatts.

The maximum efficiency obtained on unit No. 1 was found to be 87 per cent. at 87 per cent. load; the maximum efficiency obtained on unit No. 2 was found to be 87 per cent. at 90 per cent. load; the maximum efficiency obtained on Unit No. 3 was found to be 88.2 per cent. at 93 per cent. load; the maximum efficiency obtained on Unit No. 4 was found to be 89 per cent. at 91.5 per cent. load.

The variation in the maximum efficiency obtained in the four units is due to the fact that the runners of the units are of a slightly different design. The wheels were designed for an ultimate head of 525 feet, which will be obtained on the completion of the dam. The present head, or the one which existed during the time of the efficiency test, is 420 feet. The above mentioned percentages of load are based on full load being 14,000 horsepower, which is the designed full load condition for the units under the present head.

Owing to the high efficiency, along with the slight overload capacity allowed for in the design of the units, it is figured that when the wheels are operated under the maximum head of 525 feet and at wide-open gate, each unit will have a capacity to deliver 20,000 mechanical horsepower to the generator which it drives. Thus, the capacity of each unit is four times that of each of the units first installed, in Power House No. 1 of the Niagara Falls Power Company, in the early nineties. The Niagara units have a capacity of 5000 horsepower each, and at the time of their installation they were the largest in the world.

Facts About Some High Priced Aluminum Solders *By F. A. Dixie*

Every once in a while some smart young fellow drops in at Dixie & Yank's with another of those wonderful guaranteed aluminum solders. The only way I can account for their picking our shop out is by associating them with the "Tramps Union" written up in one of the monthly magazines recently. This idea has obsessed me to such an extent that I offered a prize to any apprentice who would find a chalk mark on our building denoting in tramp hieroglyphics that it was Goodthing & Easymark's shop.

We don't make aluminum castings and don't care how many blow-holes there are to fill in the castings we buy—provided we find them before any machine work is done.

But the young fellows blow in just the same—tell how good the stuff is and how cheap. The prices range from 60 to 75 cents a pound and the stuff is, all of it, the best ever—nothing else but the sample each one has will do the trick—the others are all fakes.

As Yank is a silent partner—he's been dead for 15 years—and as he lived the life he did, I don't think alloys with a low melting point would interest him now, and as I don't know anything about chemistry or analysis or that kind of thing, I just kept the samples left with me waiting for a time when I could get hold of someone who did know and having no ax to grind would tell the truth about them.

I found him today, I showed him my samples and from a drawer in his desk he brought forth a sample for each of mine and with each a paper giving the analysis. No. 1 was made of 6.31 parts tin, 1.57 lead, 92.12 zinc. No. 2 29.93 tin, 0.15 lead, 33.78 zinc, 36.14 cadmium. No. 3, 66 tin, 34 zinc. No. 4, 71 tin, 22 zinc, 7 aluminum. No. 5, 35 tin, 29.5 lead, 35.5 zinc.

My friend then said: "The lead in No. 2 was probably an impurity in the aluminum. Any aluminum solder containing lead in any appreciable quantity is of no use. Any mixture of tin and zinc or tin, zinc and cadmium is all right as far as it goes, but they are all the same and must be applied to the clean castings as soon as they leave the molds. Aluminum oxydizes very quickly and this oxide must be removed and the solder applied at once before the oxide has time to form again. As regards price, No. 3 sells for 75c. per lb. and costs between 15 and 20 cents to make."

So I am ready for the next aluminum solder man.

Concerning Small Tools and Toolmakers

By John R. Godfrey

One of the little problems which presents itself to the shop manager who is carefully studying details in pursuit of the elusive dollar, with which to gladden the hearts and pocket books of the stockholders, is the question of the machinists' small tools and the other supplies, such as files, emery cloth, etc. It is common practice for the workman to supply his own "kit," which may vary from a broken cold chisel and a shaky pair of calipers, to an elaborate chest with $100 worth of tools, more or less, while the shop usually supplies files, emery cloth, etc.

Although the men as a rule prefer to have their own small tools and take pride in them, it is an open question whether they should be compelled to buy them any more than the monkey wrenches, drill chucks and similar tools, which cost no more than some of their micrometers. And there seems no reason why some of these small tools should not be kept in the tool room and issued by check, than the ones which are usually supplied for this purpose.

Aside from the cost of tools to the workman, there is the question of accuracy of scales and micrometers, which may make considerable difference in the work which is turned out. If these are owned by the firm, kept in the tool room and tested for accuracy from time to time the same as any other fine tool, the chance of error from this source is greatly diminished. Then, too, the error arising from a difference in scales, which is often perceptible, would be obviated by carefully testing all scales bought, and rejecting those which failed to come up to the standard; the workman has no means for doing this and cannot be held responsible for errors arising from this source. Shops using the gage system practically supply calipers to their men and the foregoing does not, of course, apply to them.

There are now very few shops which do not furnish files and similar supplies to their men, but I have known of more than one shop in the country compelling the men to buy them, and not only this, but to buy them *of the firm they work* for. This naturally created friction, for even if they sold a superior article at a low price, no man likes to feel compelled to buy at a certain place. As a matter of fact, they did not sell the best and the men often carried files which they consider better and more economical for them, at the risk of detection and possible discharge. Petty tyranny of this kind cannot be too strongly condemned. If the men must buy their own supplies in the name of fairness let them buy them in the open market where the firm buys their supplies.

But while it is a notorious fact that the file expense of a shop is one of the hardest to regulate in an economical manner there seems to be no more reason for a workman buying them himself than in furnishing the lathe he runs, or paying rent for the room he occupies in the shop. It seems more reasonable to suppose that the tendency will be the other way, as suggested at the beginning, and that all tools which the workman uses will be furnished by the employer, as this would be to his advantage ultimately in securing a better class of work.

Consulting the Toolmaker

Although there is nothing mysterious about the toolmaker's work, it seems to be clothed in a little different raiment from the rest of the work and the toolmaker is usually looked upon as a little above the ordinary workman and he generally is. His work is finer and more depends on its accuracy than with ordinary work, as while a mistake on ordinary work only spoils one piece, an undiscovered error in a tool may spoil a thousand pieces. Then too, there is more care taken in making a tool, and if many errors occur, or many pieces of work are spoiled a new toolmaker is in order and of course, this also applies to the machinist.

There is a difference, too, whether the toolmaker is in a large or small shop; in the large shop the tools are usually planned in the drawing room, too often without asking the advice of the toolmaker, and the toolmaker then becomes a follower of drawings the same as any other workman, with the same difference as before, that the work is a little finer than that of the average machinist.

In the small shop the personality of the men cut more of a figure than in the large shop and the toolmaker very often has to devise his own tools after the foreman's order as he brings a piece of the work to be done, or shows a sketch of it with:

"Well, John, get us out some tools for this; no fancy work, just plain tools that will do the work, same as the last ones you made."

And John thinks out the tools for himself. This is the kind of a toolmaking job that John likes to have, though it isn't always possible in large shops, but it will generally be a saving of money to consult with the toolmaker in any case, as the man who has to make the tool will generally know the easiest and cheapest way to do it.

Driving Machine Tools

The question of applying power to machine tools is always of interest to designers and shop managers, and the advocates of the various methods can all convince you, to their own satisfaction at least, that belts, gears, chains or electric motors, as the case may be, have all the advantages.

The fast running belt with ample pulley contact has many advocates, most of whom are perfectly willing to admit the many mistakes that have been made in this direction before, and who claim low first cost, flexibility and reliability. There can be no question as to the ability to secure transmission of power from belt if we can use them wide enough and run them fast enough, because in most cases the whole power of the factory is transmitted through a main belt.

The main difficulty is in shifting belts to obtain different feeds, although we often think it necessary to use more of these than are actually required, and this calls to mind the system which was devised a number of years ago by Frank H. Crafts, of Buffalo, N. Y., and was installed in a number of very large shops at that time. I find this was illustrated in the American Machinist on July 17, 1902, and that 6-inch belts were used on 24-inch lathes, 7-inch on 30-inch lathes, and 8-inch on 36-inch lathes, which was an anticipation of the demand on machine tools of the present day. These were endless belts, one belt being supplied for each step of the cone or for each speed required in the case of a single-pulley lathe head which was built at that time. Any desired belt was thrown into action by an idler, and if testimonials are worth anything this worked out very satisfactorily. The fact remains, however, that this method is entirely unknown to the majority of machine-shop men, which shows how quickly we forget things that we do not see every day, and should be an excellent slogan for an advertising man to use.

From a consular report, it is noted that rapid progress is being made on the Antung-Mukden Line, the new Japanese railroad. Thirty-three miles of the Antung end of the line were opened for traffic on November 3. The roadbed of this section has already been ballasted and is in good condition. In sections all along the line the grade has been finished, or is nearing completion, while of the total length of 166 miles it is estimated that 45 per cent. of the grade work, in point of miles, has already been completed. This does not mean that 45 per cent. of the actual work has been completed, because of the numerous, and in some places difficult tunnel work. Except the thirty-three miles already completed the route of the line lies almost wholly in a mountainous and very rough country. The road will probably be open for traffic by January 1, 1911.

Machining Buick Engine Cylinders *By F. F. Lake*

The Buick Motor Company, Flint, Mich., is without doubt turning out more automobile engine cylinders, as well as finished automobiles, than any other plant in the world, consequently a description of the methods employed for handling and machining these should be interesting. They have made plans for turning out 55,000 finished automobiles this season and nearly all of the parts that enter into construction of these are made in their own shops. This has meant increasing their plant to a large extent, while simultaneously working the parts available to their full capacity with a night and day force.

The cylinders that are the subject of this article are shown in a pile in the lower right-hand corner of Fig. 1; these are cast in their own foundry and are of the two-cylinder and water-jacket, cast integral, type. The cores are cleaned out, the castings pickled and brought to the machine shop where the water jacket is tested with 200 pounds hydraulic pressure by the pump and apparatus shown in the foreground in the lower left-hand corner of Fig. 1.

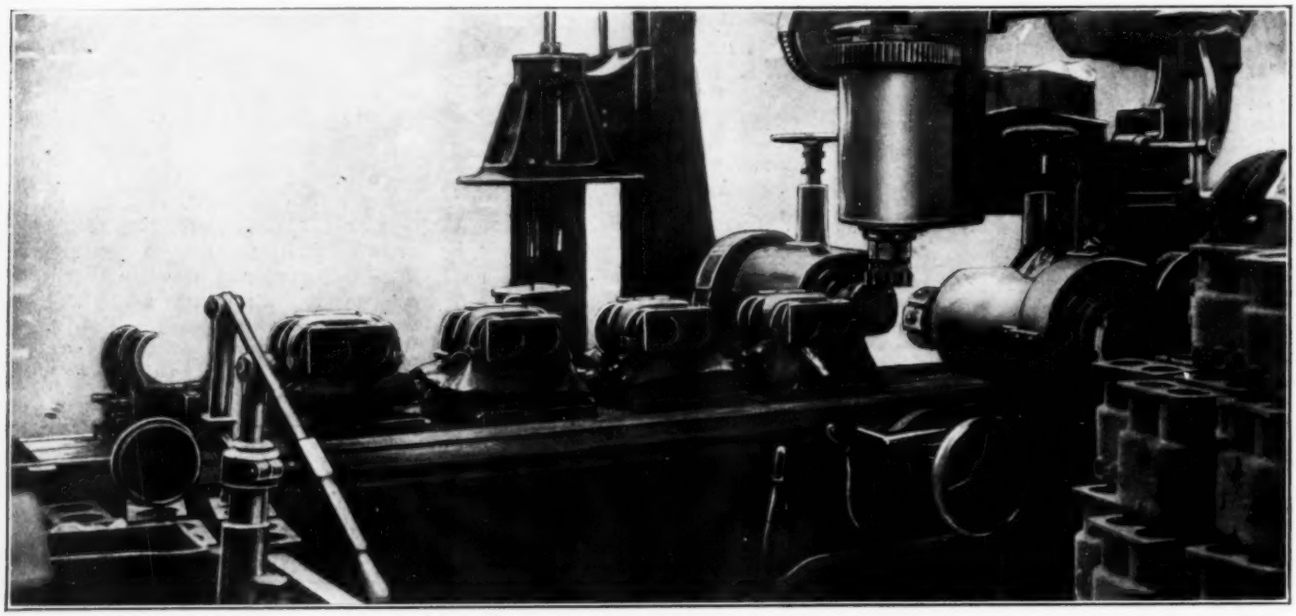


FIG. 1. FACING TOP, BOTTOM AND ONE SIDE OF CYLINDERS

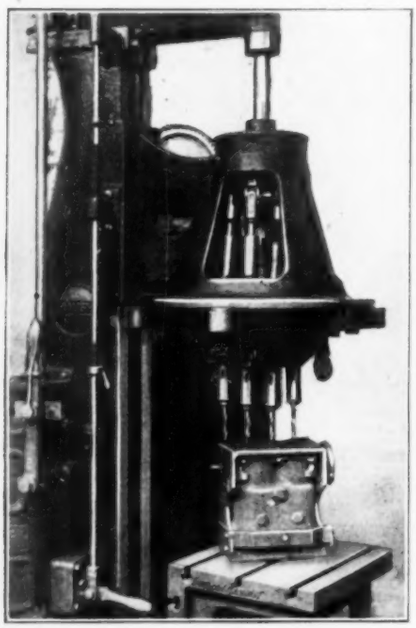


FIG. 2. DRILLING THE SIX BOLT HOLES

FACING TOP, BOTTOM AND ONE SIDE

After this they are put on the Beaman & Smith three-head milling machine for their first operation. This machine is made to work continuously by having five sets of jaws located on the platen to hold the work. After the first two cylinders have been set up, the machine is started to work milling the top, bottom and one side, as shown in Fig. 1. While the machine is working the operator is filling the other three sets of jaws with work. By this time the platen has carried the first cylinder past the cutters so it can be taken out and another put in its place. Next the second cylinder is replaced by a fresh one and by this time the platen has reached the end of its travels so it can be reversed and the operations repeated. Thus as fast as the cylinders are machined they are set up and as fast as they are set up they are machined. In a day of ten hours, 175 cylinders are machined on three sides with this machine, and when taken out they are set down back of it to be picked up and drilled in another machine shown in the background.

This second machining operation consists of drilling the 6 bolt holes, as shown

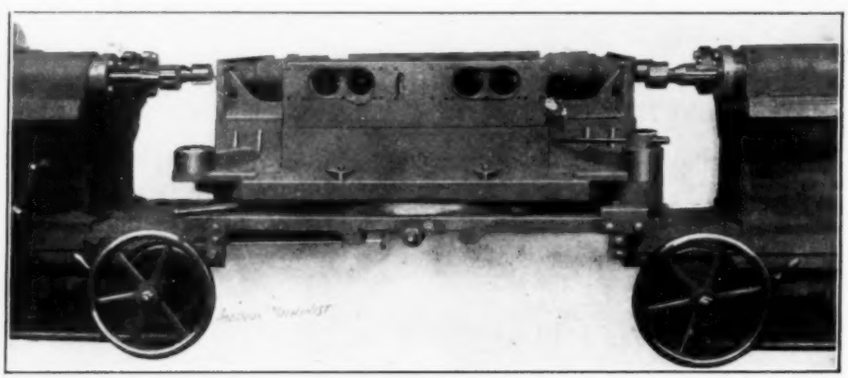


FIG. 3. ROUGH BORING FOUR CYLINDERS SIMULTANEOUSLY

in Fig. 2, for securing the cylinders to the crank case. The cylinder is located in a jig and fastened by a bar at the bottom and a pair of jaws at the top that are made to clamp the cylinder by the hand wheel. The holes are then drilled by the Baush multiple-spindle drill press, as shown.

Rough Boring

The third operation consists of rough boring four cylinders simultaneously in the Newton machine shown in Fig. 3. This is a double-end machine with two boring bars located in each end, that travel into the cylinders. In the center is a revolving turret that holds the work and also has a motion sideways. Four cylinders, one in each of the four castings, are drilled simultaneously and the turret is then moved sideways into the position for boring the second hole in each casting. While these are being bored four other castings are being set up ready to bore, after which the turret is revolved so that the finished castings can be taken out and others put in their place, while the machine is boring the second set; thus the machine is kept in continuous operation.

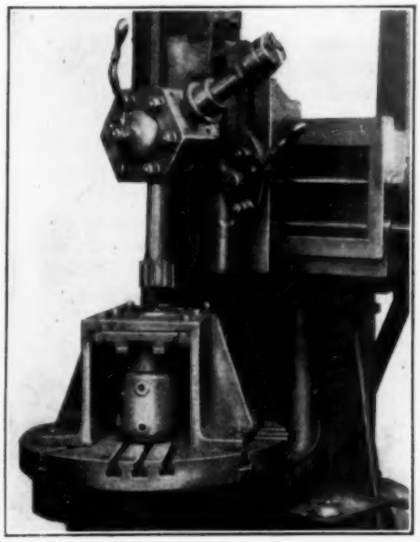


Fig. 4. Finish Boring Cylinders

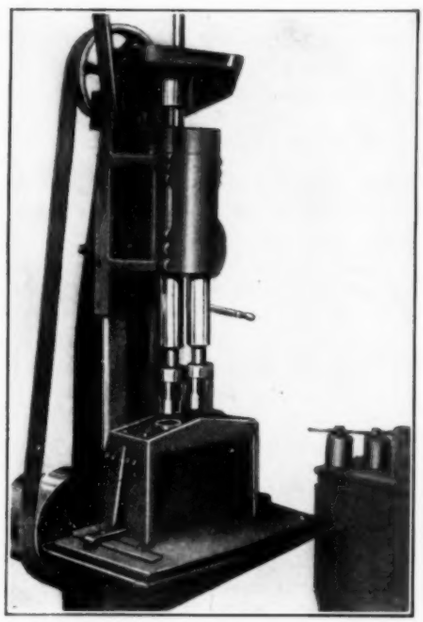


Fig. 5. Reaming the Cylinders

This machine, as well as the drill shown in Fig. 2, must keep up the pace set by the facing machine shown in Fig. 1 and machine 175 castings per day of ten hours. It is the intention of this department to turn out 150 perfect cylinder castings and the extra 25 are machined on the first machine in order to make allowance for those that have to be thrown out for flaws. Here 1/16 inch is left for finish boring.

Finish Boring

After the rough boring is done the castings are taken to the Bullard vertical turret machines, located near the end of the rough boring machine, for the finished boring and bottoming operations, as shown in Fig. 4. Two of these machines are kept going to keep pace with the other machines. The castings are located in jigs as shown, where they are finish bored by the tool which is about to enter the casting. After this the finishing tool is swung around and the bottoming tool, shown in the upper part of the turret, is brought into place for finishing the

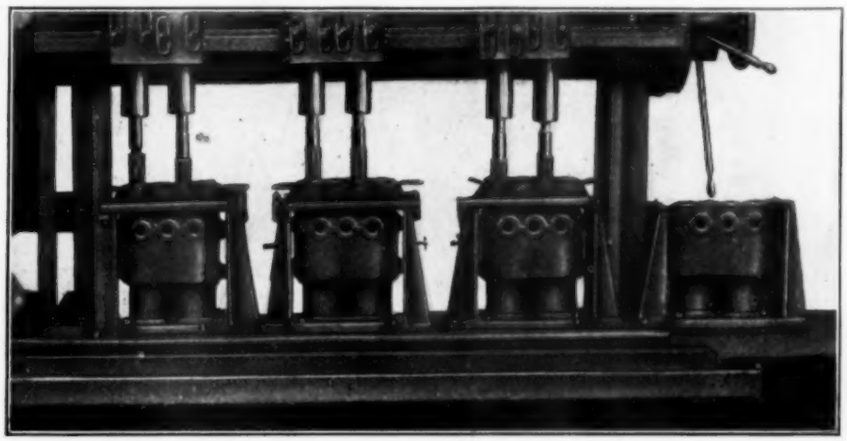


Fig. 6. Drilling, Reaming and Tapping Valve Openings

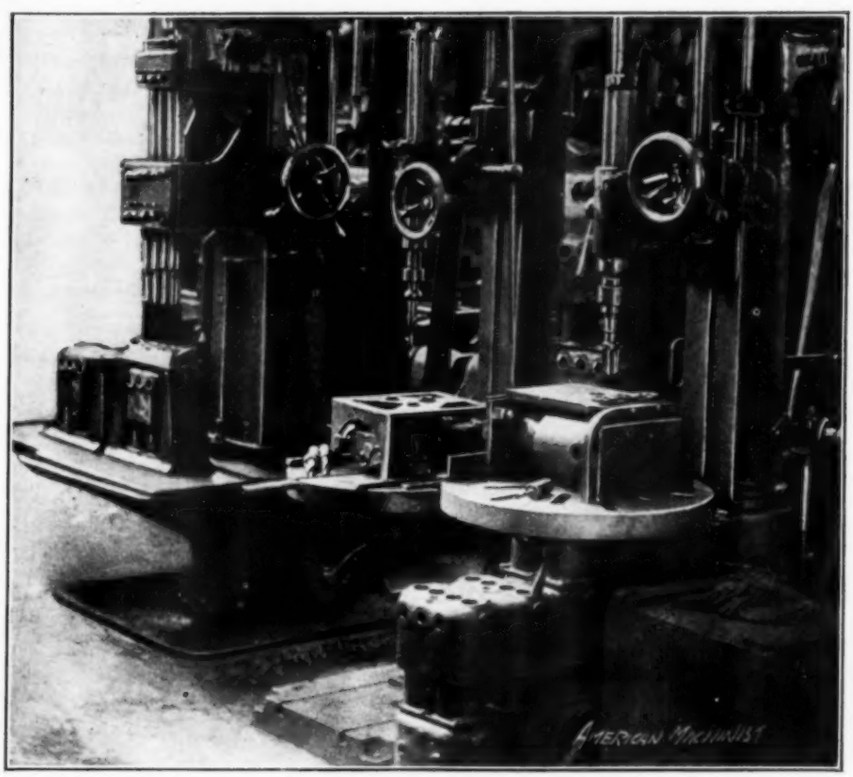


Fig. 7. Drilling and Reaming Operations

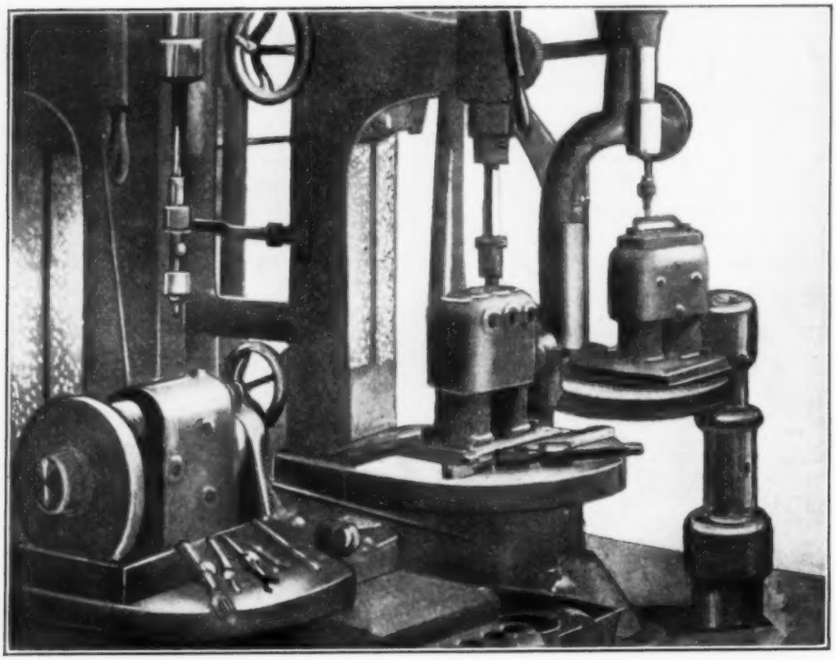


FIG. 8. DRILLING AND REAMING OPERATIONS

bottom of the bore, which would be the top of the compression chamber. In finish boring 0.020 inch is left for the reaming operation.

REAMING

In Fig. 5 is shown the next operation, which is reaming out the bore of the cylinder. This is done in a double-spindle machine and both cylinders are reamed out simultaneously with two reamers. Here the bore must be finished so that it will not be more than 1½ thousandths over or under the size required. To test this the two plug gages shown on the bench to the right of the machine are used; one of these is 1½ thousandths over size and must not enter the hole after it is reamed, while the other is 1½ thousandths under size and must enter.

Between this and the former operation the cylinders are allowed to stand for at least 24 hours so that all of the internal strains will relieve themselves and the casting stay as it is left by the reaming operation. Before the engine is assembled and after all the machining operations are performed the piston with its rings is put into place and the surfaces worn to a glazed finish that will make the piston and cylinder bore fit each other.

VARIOUS OPERATIONS ON DRILL PRESSES

After the bore is reamed the cylinders are taken to the multiple-spindle drill press shown in Fig. 6 where the valve openings and seats are drilled, reamed and tapped. This machine is also kept in continuous operation by having an extra jig, as shown at the right of the machine so that the operator can take out the finished casting, put another one in its place and carry it to the other end of the machine where it is slid into position after the other castings have been moved down to the other tools. This machine finishes about 165 castings a day of ten hours.

After the valve openings are finished the castings are taken from one machine to another, down one side of the gangway and back the other, as shown in Figs. 7 and 8, where the numerous holes are drilled, tapped, reamed, counterbored, etc. Jigs are provided for each operation so they will all be alike and interchangeable. In the last of these operations, as shown to the left of Fig. 8, the operator chucks ten tools and turns the casting back and forth to drill, tap, ream and counterbore holes on three different sides. With these numerous operations he turns out 160 finished castings in a day of 10 hours.

Boring Double Tapers in Core Boxes

BY WILLIAM R. SWIFT

Sketch No. 1 shows a section of a multiple core box of twelve holes, each 29/64 inch in diameter, at the smaller end of taper, which it fell to my lot to make.

The old way of doing this kind of a job would be to bore the one taper in all the holes and then reverse the box and bore the opposite tapers. This makes it a very hard and tedious job, inasmuch as it is almost impossible to get the one hole true with the other. If one taper was out the hundredth of an inch, the casting would show a fiftieth of an inch thicker on one side than on the other, which would spoil it.

In order to surmount this difficulty, I devised a simple and practical method whereby I could bore the two tapers easier and quicker than I could by the old method, and furthermore they were absolutely true with each other. A tool was made by taking a piece of 5/16-inch round Stubb's steel and flattening the end to 7/16 inch, as shown in Fig. 2.

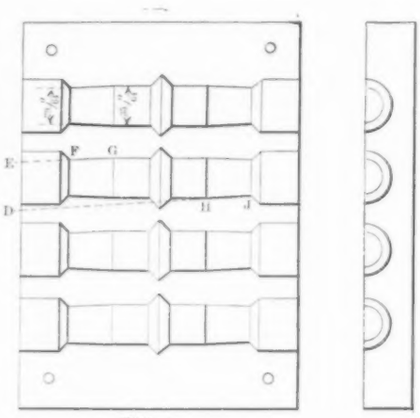


FIG. 1

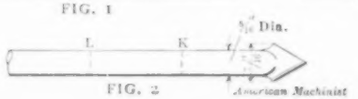


FIG. 2

BORING DOUBLE TAPERS IN CORE BOXES

This makes a double boring tool with 1/16 inch on each side of the body of the tool.

It will be observed that the plane of the cones on one side of the front end stands parallel with the plane of the cones on the opposite side of the back end, as shown by the dotted lines *D* and *E*. By setting the top slide of the lathe rest parallel with the lines *D* and *E*, I was able to bore the front end by feeding the tool from the front of the bore to the length of the taper required, as marked from *F* to *G*, which is indicated by the mark *K* on the body of the tool.

To cut the straight section of the hole, the tool was allowed to travel straight along to the point *H*, the distance of which was indicated on the body of the tool by the mark *L*. Then by moving the tool to the other side of the hole and feeding it along the line *H* to *J*, the back taper was bored.

The above, as anyone who is familiar with the boring of double tapers knows, is a very great improvement over the old method, not only saving time, but also assuring the accuracy of the tapers.

LOCATING BEVEL GEARS of MOTOR CAR AXLES

Interesting Machine for Measuring Space between Abutments

BY HUGH DOLNAR

At this moment American motor-car building practice declares, almost as a unit, in favor of the "shaft drive," a universally jointed shaft with bevel pinion and gear to divided live rear axles coupled by the "differential" or balance gear. This preëminence of the bevel-gear drive gives great importance to the various methods adopted by different rear-axle builders to locate the bevel pinion

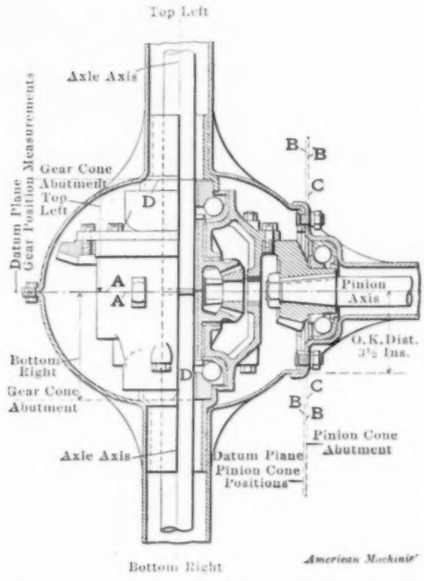


FIG. 1. DIAGRAM OF BEVEL GEARS AND LOCATING PLANES AND MEASUREMENTS

and bevel gear in precisely the best relative positions, and, when these correct locations are once found, to retain the bevel pinion and gear in those best relative positions beyond all doubt, question or peradventure.

THE BEVEL GEAR DRIVE

This article deals solely with the bevel pinion and bevel-gear drive and shows, in some detail, the methods and special appliances employed by the American Ball Bearing Company, Cleveland, Ohio, a large producer of motor-car front and rear axles for the trade, to obtain and retain a reasonable correctness in the relative positions of the bevel pinion and bevel gear in the gear housing, which is the midway element lengthwise of the "shaft-drive" rear axle.

CORRECT GEAR PLACING AND ACTION

As is well known, plain bevel gears—pinion shaft and gear shaft at right angles—are correctly located when the points of their pitch cones meet each other with the axis of the pinion cone at right angles to the axis of the gear cone. When thus correctly positioned in relation to each other, the bevel pinion and gear form an admirable power-transmission agency, smooth and silent in action and durable if made of suitable material suitably treated; while on the other hand, if the gear and pinion are so located that their respective cone points do not meet, or meet at some other than right angles, then the bevel-gear drive becomes noisy, is full of shocks in action, wears rapidly and is a constant source of power loss, vibration and annoyance.

BEVEL GEAR SCREW ADJUSTMENTS

Well knowing that the bevel pinion and gear demand exact placing, and finding it difficult to machine the rear-axle gear housings to absolutely correct dimensions assuring this correct gear placing, the first bevel-gear drives were fitted with screw adjustments by which the pinion and gear positions could be shifted; with, of course, the certain result of misplacement through ignorance of workmen and displacement through road shock and vibrations. All this led finally to fixed locations for both pinion and gear, made right in the factory and impossible to change without removal or addition of metal.

BEVEL GEAR DRIVE AXLE CONSTRUCTION

The bevel-gear rear axle includes a dust-proof gearing inclosure and must, therefore, include separable hollow incasing elements at right angles to each other, having three openings—one to permit the entrance of the pinion shaft and the other two at right angles to the first, to permit the egress of the live axles. Since the whole rear-axle assembly must be as small and as light weight as is consistent with its load-carrying and power-transmission requirements, the American Ball Bearing Company began, in June, 1907, to substitute pressed-steel gear housings 3/16 inch thick, for the steel, bronze, malleable cast-iron and aluminum casting gear housings previously employed, in connection with steel-tube axle sleeves electrically welded to the pressed-steel housing cups; the tubular-steel pinion shaft sleeve was applied to the united halves of the gear housing by a pressed-steel flange and bolts or screws.

The bevel pinion and gear are made of steel, commonly specially alloyed for this service and hardened or "heat-treated" to give the gear teeth strength, hardness and wear resistance, with almost unlimited variations of practice details in both material and treatment.

But, leaving all questions of bevel-gear and pinion materials and machining and heat treatment aside, the constructor may at least hope to so position the pinion and gear as to obtain the best operative results possible. The description and pictures that follow will convince the machine-construction expert, who carefully studies them, that the methods and appliances for correct bevel-gear placing here exhibited are novel and effective.

PRESSED-STEEL CONSTRUCTION DIFFICULTIES

When working thin, perfectly ductile stock, the drawing press produces metal

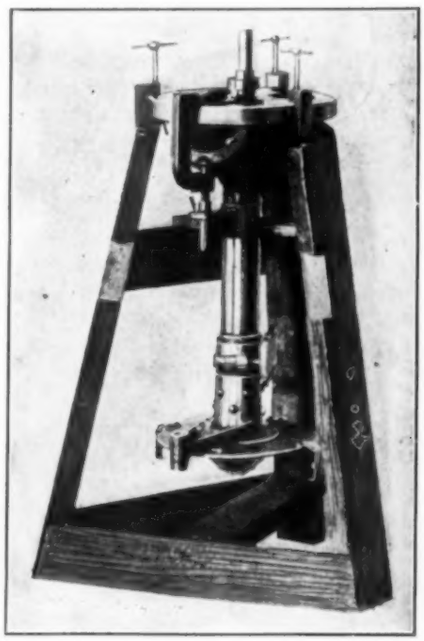


FIG. 2. HALF HOUSING READY FOR FIRST MICROMETER MEASUREMENTS

forms very nearly alike; but where the stock to be worked is heavy and not in all parts of exactly the same hardness, as in case of 3/16 inch thick pressed-steel gear housings, the form and outside dimensions of pieces from the same dies are certain to show measurable variations. Because of the small stock thickness only little depth of finishing cuts is permissible and it is much more difficult to accurately machine the pressed-steel gear housings than those made of castings. Thus the

Ball Bearing company found itself forced to devise some method by which the pressed-steel gear housing dimension errors could be compensated by means which would in themselves assure the correct location of the bevel pinion and gear without special trying and fitting, and without pairing numbered components in sets.

Bevel Pinion and Gear Placing

The pinion axis and the gear axis must be at right angles to each other and must lie in the same plane; when these conditions are met, moving the pinion inward or outward or moving the gear toward or away from the pinion, will give the gear and pinion their correct relative working positions. Of necessity, both the pinion and the gear must have fixed position locating abutments in the pinion and gear housings. Hence, it is evident, that if the pinion and gear can once be correctly placed, and measurements can be made and recorded to show their actual pinion-hub and gear-hub positions, while other measurements can be made and recorded of the pinion-hub and gear-hub abutment positions in a given axle construction, then the correct thicknesses of washers to be placed between the hubs and their abutments to bring the pinion and gear to correct position in the axle assembly can be determined. This is what is done by the American Ball Bearing Company in fixing the pinion and gear positions in the assembled rear axle.

Pinion and Gear Placing Machine

Obviously the first step in carrying out this projected method of fixing the pinion and gear positions by means of washers of known thickness properly located in the gear and pinion housings of the completed rear axle, was to devise some machine in which the pinion, with the gear carried on its own ball bearings, can be placed so that the pinion axis intersects the gear axis at right angles. This machine also includes means for adjusting the pinion and gear relatively until they are in their best working positions, as well as measuring appliances by which the gear ball cone-end positions could be defined in measurements comparable with the cone-end abutment measurements in the pinion and gear housings.

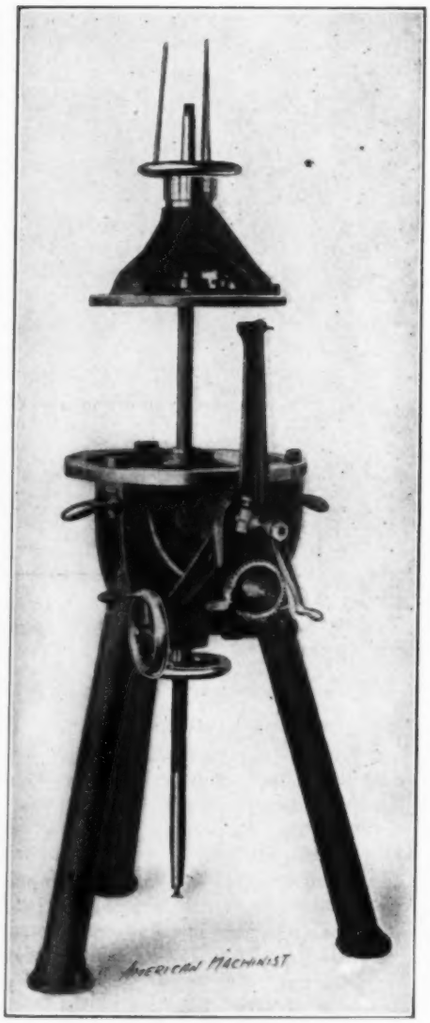


Fig. 3. The Gear-positioning Machine

Datum Planes

There are four surfaces in the rear-axle assembly from which measurements can be taken defining the required washer thicknesses. See Figs. 1, 3, 4 and 5.

The datum surfaces *A A*, from which both of the housing abutment locations for the bevel-gear bearing cone abutments, and also the locations of the ball-cone abutting ends can be measured, are the meeting flange faces of the pressed-steel gear-housing cups. The datum surfaces *B B* from which the pinion cone-end position and also the position of this cone-end abutment in the pinion housing, marked *C C*, in Fig. 1, can be measured, are the meeting faces of the pinion-sleeve flange and its finished seat. Part of this seat is located on each gear-housing cupped half. The measurements from the datum plane *A*, Fig. 1, to the top or left-hand gear-cone abutment in the left axle-housing member, and from the same datum plane to the corresponding gear-cone abutment in the right-axle and gear-housing member, are of considerable length while the distance from the pinion position measuring datum plant *B*, Fig. 1, to the pinion-cone abutment plane *C*, Fig. 1, is small. The "top-left" and "bottom right" measurements fix the gear location with respect to the pinion axis, and are recorded on a form blank, Fig. 6.

Record Form Blank

(See Fig. 6.) This form blank has nine vertical record columns as follows,

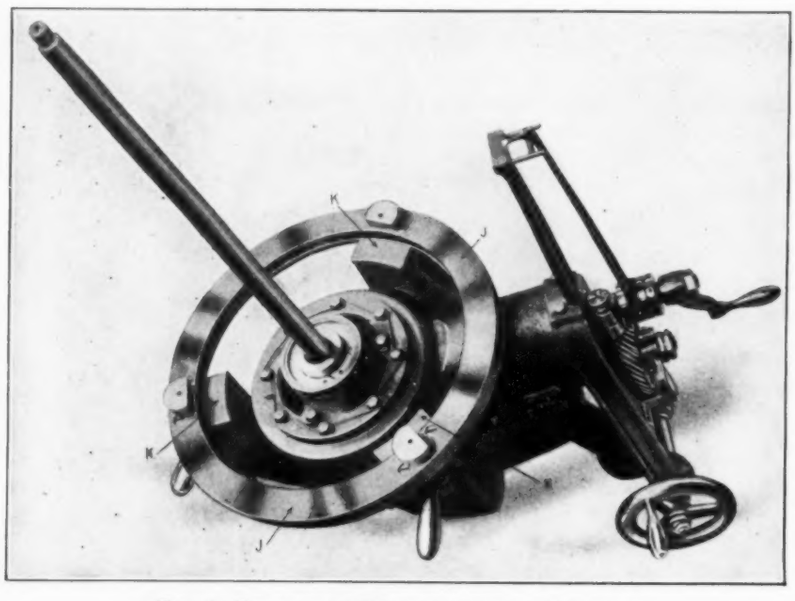


Fig. 4. Details of Gear-positioning Machine

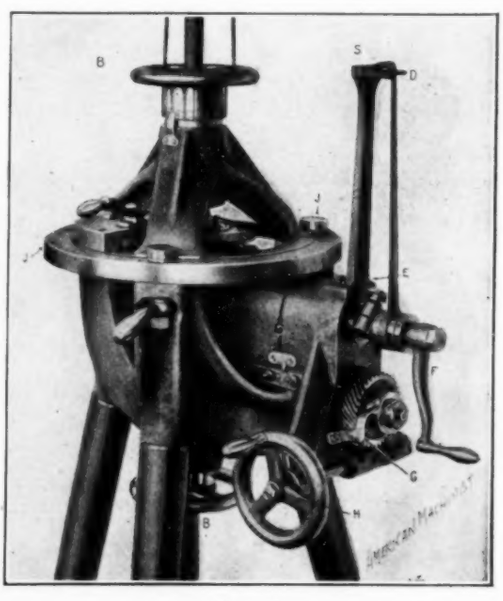


Fig. 5

beginning at the left: The first "Equip No." is filled with the factory production-order number by the foreman of axle assemblers. The second "Shop No." is filled with the right and left gear-housing pairs, numbers stamped on the housings meeting flange faces after the pinion-sleeve flange seat has been finished. This stamped number pairs axle members, which are kept together thereafter. This second column and the remaining seven columns of the record form are all filled in by one man, a specialized laborer, called the "gear-position fixer." He adjusts the pinion and gear to their best working positions, makes and records all the gear-position fixing measurements of the axle members, and places washers of correct thickness in the axle components.

Thus each line of this record form is made to show all the gear-locating measurements of one axle and the axle shop number and production-order number.

This grouping of components by the gear-position fixer for delivery to an axle assembler avoids all numbering of axle components, save the right and left gear and axle-housing members, partly machined in pairs, and hence of necessity kept together thereafter. The filling of the seven remaining record-form columns is specified under the "Gear Position Fixing Routine."

After the shop-numbered axles of one record form are assembled the assembling foreman fills the production-order number first column of the record form, which is then filed away, bearing a complete record of the gear-position fixing measurements of axles bearing the shop numbers appearing on the record sheet.

THE AMERICAN BALL-BEARING COMPANY

READINGS TAKEN ON TWO-PIECE STAMPED AXLES

Equip. No.	Shop No.	Gear and Pinion			Casing			Off Center
		Top, Left	Bott., Right	Pinion	Top, Left	Bott., Right	Pinion	
		(A)	(B)	(C)	(D)	(E)	(F)	(G)
	390	174	191	179	229	240	208	+3
	641	140	151	179	223	235	276	+17
	803	164	173	178	226	230	281	+10
	699	161	170	190	233	240	256	—6
	744	159	134	141	204	231	296	O. K.

FIG. 6. RECORD OF MEASUREMENTS FOR LOCATING GEARS.

THE GEAR-POSITION FIXING ROUTINE

This is worked by the gear-position fixer aided by one helper in handling and placing components and using a shop-floor plant consisting of a wooden bench holding boxes of washers, one thickness only in a box, varying by single thousandths from 0.020 to 0.060 inch, inclusive. These washers are steel stampings, flattened by the drop hammer and ground accurately to thickness on a Heald, magnetic-chuck, piston-ring grinding machine.

At each end of this bench is a wooden tripod (see Fig. 2), in which is placed one member of a numbered pair of housings, flange up, ready for micrometer reading of distance from the datum surface *A*, Fig. 1, to the gear-cone abutments. Fig. 2 also shows a micrometer in place for this reading and an outside micrometer at the left of the axle tube, by which the "off center" reading of the pinion-shaft housing flange seat is obtained. This flange seat is 7 inches in diameter, and if its center lies in the datum plane *A*, then the down-hanging micrometer reading will be exactly 3½ inches, but if the seat center is not in the datum plane, then the micrometer reading will be more or less than 3½ inches. This reading, marked either plus, minus or O. K., is recorded by the position fixer in the "Off Center" column "G" of the record form. The abutment-position readings from the datum planes *A A* are recorded in columns *D* and *E*.

The pinion-shaft housing-abutment distance from the datum plane *B* to the ball-cone abutment *C* is also micrometer measured, and this measurement is recorded in column *F*.

The gear-positioning machine, Figs. 3, 4 and 5, stands near the washer bench, and has overhead a suspended micrometer, balanced by counterweights, and a clip and counterweight to aid in lifting and placing the bevel gear, differential and live axles assembly into measuring position in the machine. The positioning machine takes the bevel pinion on the shaft turned by the handle *F*. This shaft is in a slide fitted to be moved to and from the bevel-gear center by the hand-wheel *H* and spiral gears *G*. Such movement is recorded by the built-in micrometer *C*. The top and bottom handwheels, each marked *B*, have micrometer hubs, as shown at the top. The micrometer screws are threaded 10 pitch and the wheel hubs have 100 graduation marks, reading to thousandths of screw movement; these micrometer readings give the differential ball-cone abutting end positions. Lastly, the index *D* may be fixed to the pinion shaft by a clamp at *E*, and has a graduated scale at *S*, all for reading the pinion and gear-tooth clearance, or backlash, by moving the handle *F* back and forth.

With the axles and gear assembly placed as in Fig. 3, the top micrometer is lowered and clamped upon the datum surfaces *K K K*, Fig. 4, inside the clamp ring *J*, and clamped to *K* by turn-around eccentric clamps, the pinion having been previously fixed on the pinion shaft. The position fixer then turns the handle *L* and moves the gear up and down and the pinion in and out until they run right, and next adds the clearance by lifting

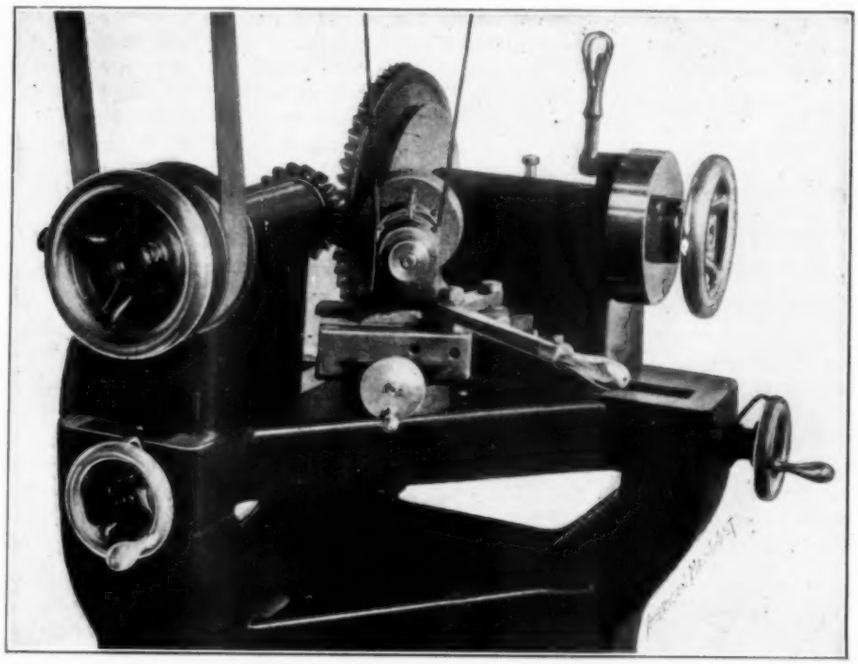


FIG. 7. ATTACHMENT FOR GRINDING OUTER ENDS OF LARGE BEVEL GEARS

the gear until *D* shows a reading of 0.007 inch on *S*. The up and down gear-cone end-position micrometer readings are then recorded in columns *A* and *B*, and the pinion-cone hub reading in column *C* of the record form. To obtain the thicknesses of washers to be placed between the ball-cone ends and the housing abutments the readings in columns *A*, *B* and *C* are subtracted from the readings recorded in columns *D*, *E* and *F*, respectively, and the gear-positioning washer thicknesses are increased or diminished respectively by the readings recorded in column *G*, according to the plus and minus signs. Then the position fixer places washers of proper thickness in their respective places. The group of components is then passed to an assembler, with the certainty that the pinion and gear will be relatively placed in the axle assembly exactly as they were in the gear-placing machine. The average for 10 hours' work of the position fixer and helper is 100 axles.

Two axle assemblers with this gear-positioning system in operation assemble as many axles as 10 assemblers did before, with almost no after corrections, while with the 10 assemblers 40 per cent. of the axles failed to pass inspection without overhauling.

Micrometer Construction and Zero

The micrometer screws are threaded 10 pitch with a circle of 100 graduations and an index which is made to stand at zero when the abutment distance measures 0.2 inch—that is, 0.2—over standard; this 0.2 augmentation bringing all abutment-position readings positive, or plus, instead of reading both plus and minus, as would be the case if the micrometer zero stood at a standard measurement. This makes simple subtraction of one reading from its related reading give the required washer thickness.

Washer-location Protection

To insure the washers from misplacement, they are dropped into the ball-bearing cone-hub seats into which the cone hubs are afterward forced until the washer is pinched between the seat abutment and cone hub, so that neither the washer nor the cone-hub can be readily dislodged; hence it would require considerable time and labor to change the washers from their right places.

Pinion and Gear-teeth Ends Set Even

There is a general superstition among garage workmen that the bevel pinion and bevel-gear teeth will be in proper respective locations if they are matched up even with each other. One bevel-gear maker shared in this belief and was greatly astonished when he was shown that in his own work the maximum variations from flush when the pinion and gear were correctly located was from 1/20 inch in to the same maximum difference out, making a total variation of no less than 1/10 inch. The garage workman will, however, always place the gear teeth flush if he possibly can do so, simply because *knows* that is where the gear teeth should be.

The heaviest and most costly axle made by this company has a 14-inch diameter bevel gear, and is too large to go in the machine shown in Figs. 3, 4 and 5. Therefore, for this big job the gears are paired and then each pinion and its own coacting gear are placed on the spindles of a Gleason bevel-gear testing machine, as shown in Fig. 7. This machine has had added to it a grinding spindle mounted on a slide with a hand-lever traverse, the spindle carrying a cupped face. The big gear and pinion are first brought to correct working positions as evidenced by the "feel" of the workman's hand when the pinion is belt driven, as shown, the gears are locked in position and the emery wheel is then worked to cut the outer ends of the teeth down to even with each other. Although this gear cutting is unusually good, the ends of the teeth sometimes show 1/16 inch out of flush with each other, and have to be ground down that much.

Recutting the Guides on a Steam Engine

By R. L. Biesemeier

An 8x20-inch Corliss engine, in the steam laboratory of the Lewis Institute, was found to have the guides out of line with the bore of the cylinder. The cylinder had been rebored several times, and it is probable that the boring was not done right and the center line of the cylinder had been shifted about one-sixteenth of an inch. As it was not desirable to enlarge the cylinder bore enough to line it up with the guides, it was decided to recut the guides in line with the cylinder bore.

The only machine available was a small planer and as will be noticed from cuts it was a very tight squeeze to get the engine frame under the cross rail. This was accomplished only after the cross-rail raising screws had been removed together with the head brace between the columns. The planer bed is just long enough to catch part of the engine frame, allowing quite a portion to overhang on each end.

There was no side head on the planer and it became necessary to devise some attachment for cutting of the guides. After considerable figuring and measuring it was found that it would be possible to do the job by the use of a motor-

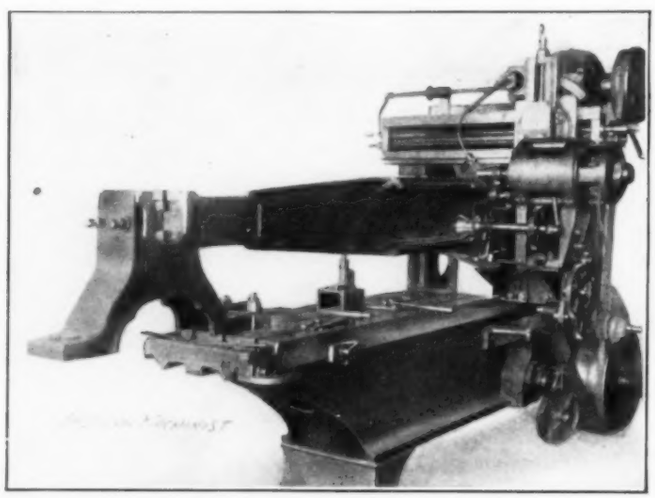


Fig. 1. Recutting the Guides of a Steam Engine

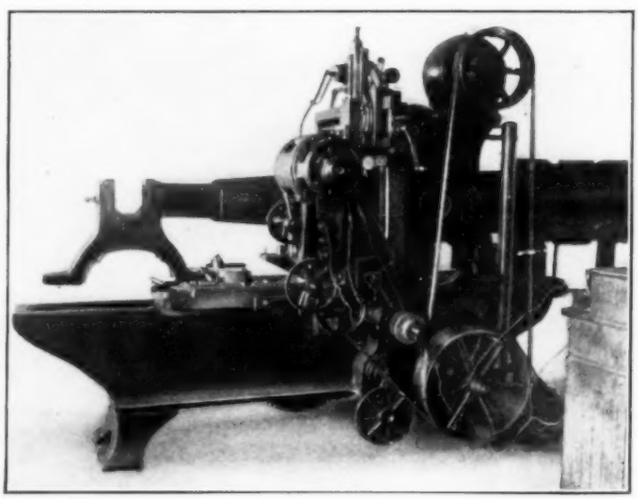


Fig. 2. The Gearing Which Moves the Bed

driven head from one of the lathes in the shop. The spindle of the lathe head was made to carry a special formed cutter of the angle of the guides. The motor was carried on a special angle plate, the upper part of which was attached to the head on the cross-rail and the base was supported by the box columns. This arrangement made it possible to secure any adjustment of the cutter for the cut, being only necessary to loosen the bolts holding the angle plate at its base, to the box columns.

Feed Arrangement

The motor on top of the planer was not used at all, the drive for the movement of the bed being secured through the motor, which was used to drive the cutter, as can be seen in Fig. 1. It was found that in order to get the right feed on the planer bed it would be necessary to make a reduction of speed for the drive, so a compound train of gears, with a reduction of 1 to 16, was carried on a bracket, and driven from the motor head, thus driving a small pulley which gave one turn of the large belt wheel to 200 turns of the cutter. This gave 0.010 inch advance of the work for each turn of the cutter. This arrangement did the work in a very satisfactory manner and made rapid production.

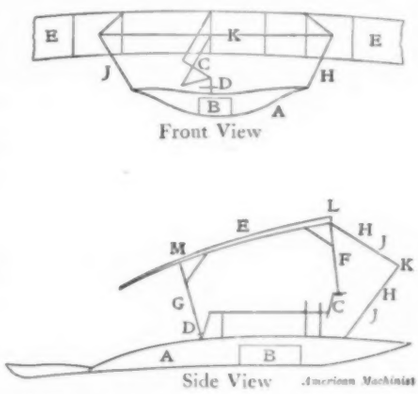
Financial Mechanics of Aviation—II

By M. C. Krarup

In a previous article in the American Machinist, page 103, the physical laws were exemplified which render all aviation projects based on small-sized models subject to just suspicion, as regards the probability of accomplishing in a full-sized machine what the model may seem to promise. It was shown that the action which produces flight must necessarily be different in a large flyer from what it is in a small one built on the same plan, just as it differs considerably between large birds and small birds or insects. The burden of proof is always on him who claims that the ostrich can fly because the quail flies; that the condor can rise almost vertically from the street to the eaves of the house, because the sparrow can do so with ease.

In order to get all efforts for the improvement of aviation concentrated in the most promising channels, it should be equally useful to have it made clear that all plans and devices (models included) which are intended to convince the mind that a man-carrying machine may be built to accomplish on some plan different from that of the aëroplane, the same kind of flight which we envy in the small bird, are almost certain to be found radically at variance with certain mechanical facts relating to the strength of materials and the transmission of stresses. These facts have been ascertained mostly through modern experience in automobile-building and are not commonly taught in schools, colleges or anywhere else, being too indefinite and complicated to afford a convenient basis for instruction. To have this difficulty in departing from aëroplane design made clear, if possible, should be so much the more desirable, as those aëronautic designers who are impatient with the limitations of the aëroplane, are very frequently men of standing and of considerable attainments in other branches of invention. The ornithopter machine and the ornithoplane, the helicopter and the gyroplane have their advocates largely among engineers and professors who see no reason why we should not be able to fly from a standstill, fly vertically, if desired, hover over one spot and choose a place of landing with deliberation; all accomplishments which are as yet beyond the aëroplane, and which many think must be forever beyond its capacity.

Naturally, there must be some difficulties in proving a case against the projects and contentions of men who should professionally be good reasoners and should have seen the error in their efforts, if this error were easily subject to demonstration in words. The error can indeed hardly be demonstrated in words alone without recourse to elaborate calculation of stresses, and figured stresses, unless purely static and relating to standard engineering materials, are notoriously unconvincing for demonstration purposes, but it may be demonstrated as clearly as is necessary by analogy with aëroplanes and with experiences in the automobile industry.



Etévé Ornithoplane or Movable-plane Flying Machine

The Vertical Thrust Type

Among the varieties of flight machines referred to, the helicopter and the gyroplane are intended to counteract gravitation by a direct downward thrust and to be capable of a direct vertical lift. The idea seems to be to produce a rotary speed of obliquely held surfaces equal or superior to the forward speed of the aëroplane and thereby to get an equal support for weight, and this idea may seem plausible at first glance.

Among the best performances of aëroplanes we find, on the other hand, such as the following. A 35-horsepower engine, working at a development of at least 30 horsepower, carries a weight of 1200 pounds at 35 miles per hour against an air resistance measured as equal to 250 pounds gravitation pressure. This last figure is obtained by measuring the thrust of the propeller and assuming it to equal the air resistance which it overcomes. The figure, while probably only approximately correct, as the means for measuring thrust of a propeller are as yet crude, is more likely to be overstated than understated. As a body falling by the action of gravity will move 16 feet in the first second, the propeller thrust of 250 pounds working to resist gravity might be considered as doing $250 \times 16 = 4000$ foot-pounds of work during this first second. This is at the rate of $4000 \times 60 = 240{,}000$ foot-pounds per minute and as one horsepower equals 33,000 foot-pounds per minute, all the power utilized for propulsion and support in the aëroplane, out of the 30 horsepower developed by the engine, amounts really to only about 7 horsepower, while 23 horsepower is wasted by reason of our inexperience in applying a thrust against the atmosphere.

To support 1200 pounds against gravitation by direct thrust should require $1200 \times 16 \times 60 = 1{,}152{,}000$ foot-pounds per minute $= 35$ horsepower. This is the power required for vertically lifting or sustaining 1200 pounds, provided the power is all utilized; but it has just been shown that present means for applying a thrust against air wastes 23 out of 30 horsepower. For hovering with 1200 pounds, as contemplated with helicopters and gyroplanes, we must, therefore, either use 35 horsepower $\times$ $30 \div 7 = 150$ horsepower, or we must rely on getting an action from helicopter surfaces or gyroplane surfaces (which are nothing more or less than multiple or enlarged propellers, with vertical axes) very much better than we get at present from propellers, whether the latter are placed horizontally or vertically. If it is assumed, against all probabilities, that this may be

done, the first logical thing to do would be to apply such a new-found principle to propellers for an aëroplane and prove out its efficiency. So long as this has not been done, the advocate of the helicopter or gyroplane has all chances against him with regard to his plan for sustentation, and, besides, owes another demonstration with regard to propulsion, which it is usually contemplated to obtain by tilting the axes of the helicopter or gyroplane, so that a portion of the thrust will be horizontal.

An associated idea in this connection is that a propeller or lifter of such efficiency as to raise 1200 pounds direct by 35 horsepower (instead of the 150 horsepower which present propeller construction would require) or even by 50 horsepower, should be able to start an aëroplane from a standstill, if the shaft were tilted to about 35 degrees with the horizon (and the planes to about 45 degrees), since the lift at a tilt of 35 degrees would be less than required for helicopter lift. Ability to start at such an angle, and also to land at the same angle, would at once give the aëroplane the advantages sought for through helicopter and gyroplane projects.

Perhaps it should be emphasized that the power figured as necessary for a direct lift refers to sustentation only, without speed, so that there is no possibility of "gearing down" the lifting action. As figured, it is "geared down" to zero, which is mere resistance of gravitation. For forward motion, either additional power needs to be provided or the forward motion must be, as in aëroplanes, of a nature to provide sustentation, and absolutely nothing is visible or claimed in any helicopter or gyroplane plans which have so far come to light, which would support the idea of getting a maximum lift from any other position of the shaft than the vertical position.

Plans for direct-lift machines logically lead to aëroplanes enabled by efficient propellers to work at high tilts and, eventually, with planes of reduced dimensions. The more one examines the principle of rotary vertical lifters, the more attractive appears the aëroplane principle of getting sustentation by constant renewal, through forward motion, of the masses of relatively quiet atmosphere against which the oblique plants are thrust and the more clearly does it appear that the constant renewal is the main secret of the power-economy in aëroplane action, though there are many facts in nature which show that the renewal, or forward motion, may be much slower than at present appears practicable.

Bird Flying Principles

In the ornithopter design, the motion relied upon for both sustentation and speed is the wing motion of birds, which, when analyzed, proves to be a combination, mainly of propeller action for the downstroke, and aëroplane action for upstroke. In nature this is helped out, when necessary, by pure aëroplane action in the bird's tail. In the ornithoplane, an attempt is made at imitating the principle of wing action in the reciprocating movements of a single, curved plane; and usually some simple aëroplane action is added.

Assuming that the power economy reached were equal to that obtained in the aëroplane, which is a very liberal assumption, and that somebody had really succeeded in imitating an efficient combination of propeller and aëroplane action, while the rest of the investigators are still struggling with the much simpler problem of finding a really efficient, simple propeller and a really efficient, simple supporting plane (one capable of giving considerable support at small speed), we would still have a very unpromising situation.

The latest plan for an ornithoplane, devised by a Mr. Etévé, captain in the engineer corps of the French army, which has been proved capable of flying when made in the dimensions of a small model, may serve for illustration. In this device a boat *A* carries an engine *B* driving a countershaft with a crank at each end, the two cranks *C* and *D* being set about 90 degrees apart. The front crank operates the front of the plane *E*, through the medium of a rod *F*, and the rear crank the rear of the plane through rod *G*. The jointed rods *H* and *J*, connected by rod *K*, steady the motion imparted to the plane. This motion is undulating and somewhat rocking, as described by the inventor in *Le Génie Civil*.

In contrast with the aëroplane, in which practically all stresses are steady, nowhere exceeding the air resistance against motion of the whole structure, since action and reaction must be alike, there is here a machine in which all forces necessary for sustentation and flight are spent, in full engine power, upon the disruption of the structure, before this power is applied to the atmosphere.

If 30 horsepower must be developed in moving the plane *E*, in order to make the plane return the value of 7 horsepower in sustentation and flight, all of the 30 horsepower must be resisted in the cranks of the countershaft, in the rods *F* and *G*, at *L* and *M*, and, decreasingly, from *L* and *M* in every part of the plane to its extreme ends, where the stresses finally come down to that minimum which is not exceeded in any part of the ordinary aëroplane, excepting only the propellers. Even in these it is found difficult to combine size with strength. The automobile offers a parallel. Suppose the 35-horsepower automobile engine develops 30 horsepower, which reaches rear wheels through clutch, universal joints, direct-drive shaft or transmission gear, differential, bevel gear, rear axle, rear-wheel hubs, spokes, rim, tires. Under the supposition of nearly all the power being used, which corresponds to the flying-machine condition, the car is racing or pulling a heavy load. Every part must resist what is left of 30 horsepower after the power reaches it. The stresses resulting from load and road obstructions, travel back from tires to axles, to springs, to frame, and are distributed, as cleverly as the designer knows how, in various strong and rigid units supported in the frame. Attempts to make the frame itself rigid enough to absorb the stresses were abandoned long ago.

In the ornithopter, with batting, reciprocating wings, and in the ornithoplane with a batting, reciprocating plane, the road shocks of the automobile are avoided to be sure, but the power stresses are at least equal, and the chances of resisting them by capable designing is reduced in proportion to the increased distance of the moved parts from the points where the power is first applied. This distance does not exceed 6 feet in the automobile, but would reach at least 12 feet in the flying machine, and more likely 20. At the same time, the means for resisting the stresses by mere increase of the dimensions of materials are wiped out of existence by the need of keeping the weight down.

Now, it has been observed how long a time was required before automobile engineers learned to produce a construction which would resist stresses due to the application of power within an area of 24 square feet, and it may be readily imagined what chance there is for resisting similar stresses in a flying-machine structure, extending over an area of 120 square feet at least, and with present resources, were likely to reach 500 square feet.

The only solution offering any chances at all for eventual success would consist in carrying the power in a rotary shaft to a considerable number of power distribution points and building at each of these points a flying equipment on a small scale, or, in other words, in relying upon a multiple construction. No great engineering experience seems to be required for judging the chances which such multiple design, which need to be united in a rigid frame, would have against the aëroplane, which in itself is much lighter than the frame alone could be in the multiple ornithopter or ornithoplane.

Mechanically and, therefore, also financially, it seems difficult to escape the conclusion that all chances for improvements in flying machines lie in the direction of improved propellers and improved planes for the aëroplane type, and

the problem of improved equilibrium will solve itself through the increased weight, reduced areas and more reliable engines which improved efficiency in propellers and planes will render practicable.

Reliable Data Difficult to Get

Efforts at developing the aëroplane are at present somewhat hampered by the difficulty which exists in obtaining wholly reliable data on the performances of aëroplanes of present construction. At the Rheims aviation meeting, from the reports of which most examples at present must be selected, engines and propellers were replaced between trials with other engines and propellers, without record being made of the change; the means used for measuring the thrust of propellers were in no case explicitly stated and, generally, the engineering control of the meeting was loose. The data must be gathered from different sources. Very likely, therefore, some inaccuracy may have crept into the figures used for illustration in the foregoing. The thrust of the propeller may have been more or less than 250 pounds gravitation pressure; the horsepower utilized may have exceeded 30. But the variations can hardly be greater than would be covered in the variations between aëroplanes of different efficiencies, and should not greatly affect the value of the reasoning presented. The uncertainty suggests, however, the desirability of arranging for a rough-and-ready method for measuring propeller thrust in combination with a given engine. Such a method would, probably, at the same time afford the readiest means for determining the air resistance to which any given aëroplane is subject, as the propeller thrust necessarily measures the air resistance with considerable accuracy, so long as the thrust is applied nearly in the direction opposite the motion. This, however, is not always the case.

MONOPOLY PATENTS SHOULD NOT BE GRANTED

Where the Present System Fails and a Few Suggestions

BY H. WARD LEONARD

During the march of civilization the best and most direct paths of progress have been blazed by the inventor. Commercial monopolies, on the other hand, have always been obstacles which have retarded such progress.

A patent is in effect a contract between the Government and the inventor, the intention of which is, that in return for his making known his invention he shall receive an appropriate return under the protection of the Government. But why should he receive a monopoly? The monopoly, if effective, tends to create a bar to the very progress which his invention would otherwise cause.

When such a peculiar form of consideration as an "exclusive right" is recited in a contract, it is a fair presumption that that consideration is satisfactory to both parties to the contract, and is insisted upon by one of the parties. Which party, then, to the contract which a United States patent represents, is the one which insists that the consideration to be paid to patentees shall be: "By securing for limited time to inventors the exclusive rights to their respective discoveries" (United States Constitution, Article 1, Section 8).

Certainly it is not the seller of the value represented by the disclosure of the invention, namely, the patentee, who insists that his consideration must be in the form of an exclusive right and not other form, because inventors were not, originally, and never have been since, consulted as to what would be a satisfactory form of value to be "secured" to them by the Government, in return for the value they have created and made available to the nation.

It is evidently the Government, as one of the contracting parties, who insists that the sole value it will "secure" to the inventor is in granting to him for 17 years, the exclusive right to his invention.

It will be most unfortunate for the future commercial progress of the United States, if the sole return a meritorious inventor can obtain from the Government is the notoriously ineffective patent of today.

The best of the inventions which are patented today are acquired by the trusts and boards of patent control on terms such as to discourage the inventor from taking out, at his own expense, any other patents. Inventors who combine business ability with inventive capacity, confine their efforts to detail inventions, such as they can keep secret and can manufacture with small capital; and those who lack business capacity become embittered failures, and their inventive ability is lost to the nation.

Pertinent Queries

An examination of the existing situation as regards United States patents leads naturally to the queries:

Why does his Government force an inventor to assume the obnoxious role of a monopolist?

Why should not an inventor have the same right as other producers, to receive some form of definite tangible return for the acknowledged value the Government has received from him?

Why should not the inventors have some voice in the consideration of questions involving the relations between the patentee and the public?

Why should not the public have the right to use, at once, any new and useful result disclosed by a patent, upon the payment of a reasonable royalty to the inventor who has produced the new and useful result?

Suggestions for Patent Reform

The writer appreciates his inability to suggest constructive legislation and realizes that the suggestion of a constitutional amendment is likely to make the reader skip the balance of this article. Nevertheless it being his conviction, based upon 25 years' experience and observation, that the United States is being hampered in its commercial progress by the granting of exclusive rights to inventors in the form of patents, he makes the following suggestions as to patent reforms, hoping that there may be some germ of value in the suggestions, which may be developed by those competent to deal with the subject:

1. That the words "exclusive right to" be stricken out of the article in the United States Constitution relating to patents and the words, *appropriate returns from*, be substituted.

2. That priority of filing an acceptable disclosure of the alleged invention with the Patent Office shall, in the absence of fraud, determine the question of who is entitled to a patent upon the invention. The application to contain a brief general statement of the scope of the alleged invention.

3. That the Patent Office shall promptly publish, as a provisional patent, the disclosure, together with an appropriate digest indicating the scope of the invention as far as the Patent Office officials can determine by a preliminary search of the art known to them. The applicant to pay a fee to cover the cost of such search and publication.

4. Upon the expiration of three years from such publication of the provisional patent, the inventor, upon the payment of appropriate fees, shall be entitled to have the Government determine the

scope of the invention disclosed by the provisional patent, if any, and state the invention in suitable claims in a determined patent, and at the same time determine and publish what rate of royalty, as a maximum, a licensee must thereafter pay to the inventor for the manufacture, sale, or use of the invention covered by the claims, during a period of 14 years.

The claims and also the license rates shall be subject to revision by the Patent Office upon proceedings instituted by the inventor or the public, the expense to the Patent Office in such proceedings to be borne by the party initiating the proceedings.

There shall be an appeal from any such decision to a United States court of patent appeals.

5. When such a determined patent has issued and the patentee has sued an alleged infringer, the sole defenses which the alleged infringer can raise shall be noninfringement, or that payment of royalty has already been made.

If the court determines that there is infringement of the claims, and that the royalty has not been paid, an injunction shall issue in favor of the patentee as against the infringer, together with an order for accounting and payment of royalties due the patentee. An injunction so granted shall not be vacated, except by the consent of the patentee, until the royalties due, as determined by the accounting under the order of the court, are paid to the patentee.

The party under injunction may appeal from the said decision to the said United States Court of Patent Appeals, whose decision shall be final.

Advantages of the Suggested System

Such a patent system would have the following advantages:

1. The vast amount of time and money now spent, usually fruitlessly, in trying to determine, prior to the issuance of the patent, how to define the invention and who made it, would be largely avoided because priority of filing (except where fraud was charged), would settle the question of who was entitled to the patent, and the Patent Office authorities with the published art before them could, after three years' progress in that art, state in a few claims the scope of the invention, with a degree of accuracy and fairness sufficient for the purpose.

2. Interferences, except to determine priority when fraud was charged, would be eliminated. This would eliminate the most unjust, absurd, expensive and useless part of our present patent system and would remove the incentive to fraud, perjury, forgery and conspiracy which are stimulated by the present patent system, to a most amazing degree in the case of a really valuable invention.

3. The average inventor, alone and unaided by capital, would be able to secure a reasonable return for any real value he has produced and delivered to the public through his Government.

In the large majority of instances the applicant would find that the prior art would prevent him from obtaining a patent upon that which he thought he had been the first inventor of, and thus there would be saved a large amount of money and time now wasted under the present system in pursuing for years appeals, interferences, etc., upon inventions of doubtful value.

4. Many meritorious inventions now suppressed by wealthy corporate owners or dominated and thus annihilated by patents owned by such corporations, would be rendered available to advance the progress of the arts and manufactures.

5. The state of the art would be continually advanced many years as compared with that under the present system because of the prompt disclosure of the inventions; and the rate of advance in every art would be much more rapid because of such prompt disclosure of the latest developments in that art.

6. A manufacturer could, with moderate capital, enter any of the most rapidly advancing arts without the enormous and unknown liabilities represented by the patents and future patents of the large corporations in those lines, and escape the terrible waste of time and money represented by modern patent litigations.

7. The dominating, obstructive and exterminating influence now represented by boards of patent control or other equivalent contracts in restraint of trade in patents, would be removed; and free competition, under a reasonable royalty, would be open to the best brains and abilities of the nation.

Every civilized man hates a monopoly. This hatred is an inherited and entirely warranted feeling, based upon the well known experience and record of past centuries. As a consequence of this universal feeling, every patentee, in endeavoring to sustain the alleged monopoly, which has been granted to him by his Government, finds that the infringers have associated with them as hostile witness to his interests, scores of men whose testimony is supposed to be unbiased, but who in fact hope that his alleged monopoly will be overthrown. Under a system of governmental license fees the testimony of such witnesses would be very different.

A reasonable patent-license fee, revised and adjusted by competent and unbiased governmental authority, would probably be just as satisfactory to the public as freight rates, or rates for gas, or similar rates so generally determined by the Government today in transactions between the public and those who control something which the public must employ in order to secure the most desirable result.

Modern civilization requires that the Government should determine the maximum rate of anything of value employed in the service of the public. Is it not clear that the inventor discloses his invention to his Government for the public service? That is the sole purpose of the publication contract which the patent represents.

Now since the patent publication is for the service of the public, why should not a properly constituted public service commission determine the maximum rates that patentee can charge the public and regulate such rates just as they determine and regulate the rates applying to other public-service matters?

In considering patent reforms it must be borne in mind that the good of the nation is the object of a patent system and that all other interests must be considered as relatively unimportant.

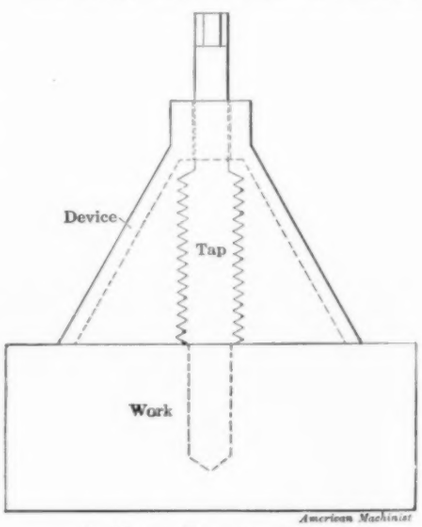
The patent system best for the nation will be that one which most rapidly and economically discloses the latest inventions; which permits anyone to make use of said inventions on fair terms, and which stimulates to the highest degree the inventive talent of the nation. Our present patent system fails utterly when tested by this standard.

A Hand Tapping Guide

By J. A. Raught

The cut shows a device I have used for several months for guiding the tap, square into the hole.

The device itself is made in different



A Hand Tapping Guide

sizes with a reamed hole to accommodate the shank of the tap. As soon as the point of the tap has entered the hole, the operator can readily see whether the tap is being held square with the work.

The device can be removed if it is necessary to tap the hole any deeper

Cutlery Grinding Machines *Editorial Correspondence*

Figs. 1 to 4 show a series of Chas. L. Joy's cutlery-grinding machines built by Hemming Brothers, Bradley and William streets, New Haven, Conn.

Fig. 1 shows a butcher-knife grinding machine built in two sizes to handle blades up to 6 and 12 inches in length respectively. The action of the machine is entirely automatic except for the inserting of the rough blade and its removal when ground. The machine can be run by unskilled labor and one boy or girl can attend to from 4 to 8 machines.

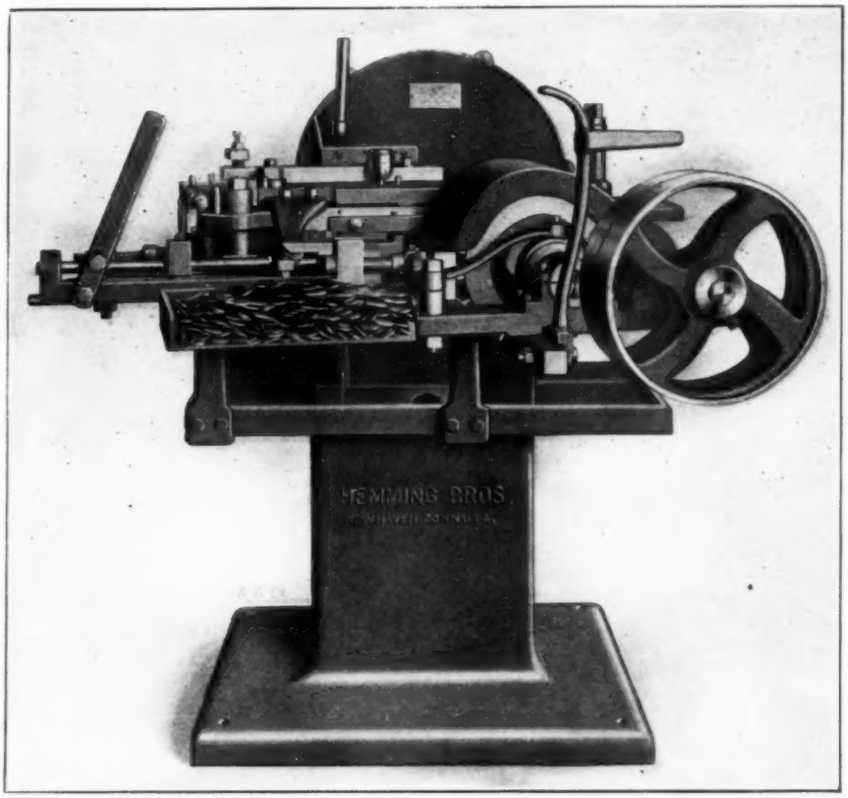


FIG. 1. BUTCHER KNIFE GRINDING MACHINE

CUTLERY "GLAZING" MACHINES

Figs. 2 and 3 show cutlery "glazing" machines with cover removed and in place respectively. This machine will automatically glaze alone, buff alone or with slight alterations can be made to combine the two operations. The term "glazing" is a trade name brought to this country by the Sheffield cutlery grinders and means the peculiar polish best adapted to take silver plating. Another of these trade terms is "whittening" which is the polish given by 150 grade emery. This "whittening" precedes the "glazing," which is done with flour emery.

One operator can attend to four of these machines and except for the inserting of the blanks and their removal when finished, the operation of the machine is entirely automatic. One operator can handle about 2000 blades in 10 hours with one operation.

To prepare the blades for silver plating takes from 2 to 3 operations according to the quality of the finish desired. A special canvas wheel is used. The blade is held against it by spring pressure so as to take care of any irregularity in the forging and the oval surface peculiar to table cutlery grinding, is imparted to the holder by means of a roller which rides over a cam.

GRINDING MACHINE FOR STEEL HAND, STUB TANG, OR ROUND TANG TABLE CUTLERY

This machine employs a ring emery or other grinding wheel. It is what is known as a double-stroke machine as it takes the knife twice across the face of the machine to "finish" grind it. The grind-

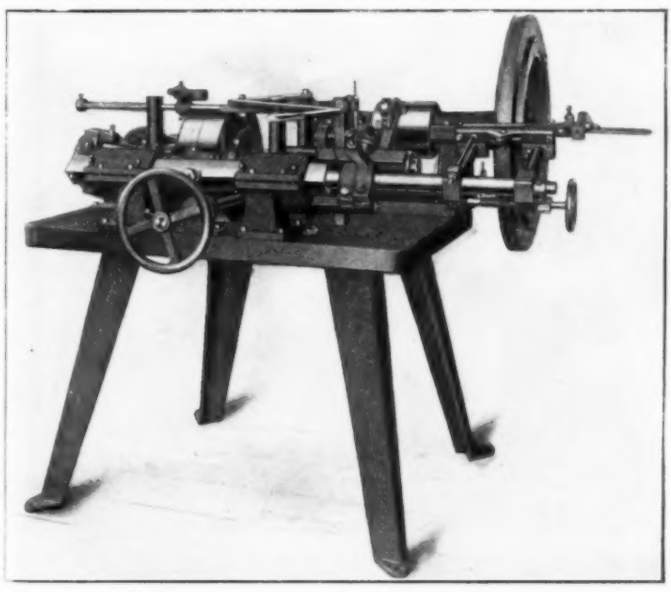


FIG. 2. GLAZING MACHINE WITH COVER REMOVED

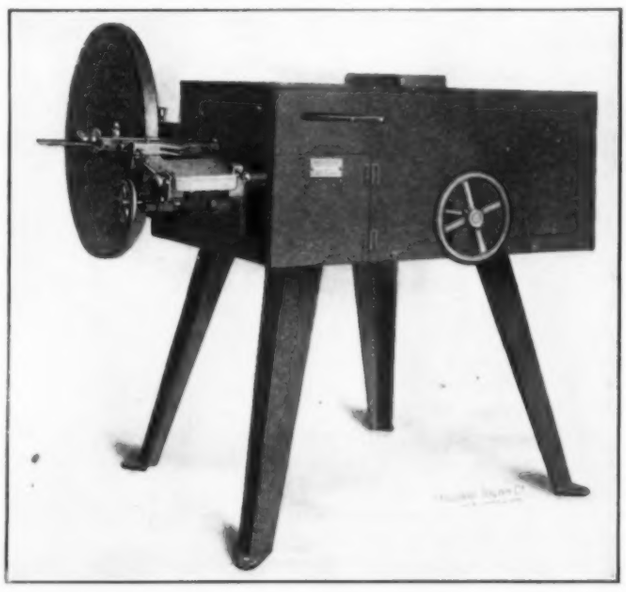


FIG. 3. GLAZING MACHINE WITH DUST COVER IN PLACE

ing strokes are from the center of the ring wheel outward so as to grind perfectly at the neck near the handle. The inward strokes of the knife are idle.

The second stroke of the machine leaves the blade in the best condition for "glazing" or buffing. A good hand cutlery grinder can grind from 600 to 800 blades per day and these, of course, lack uniformity to some extent. With these machines an unskilled operator can handle 8 machines, that is, 4 right and 4 left as the chuck which holds the knife must be set to grind one side only for economy's sake. Such an operator can grind from 2000 to 2500 blades per day and make a better job than skilled hand labor.

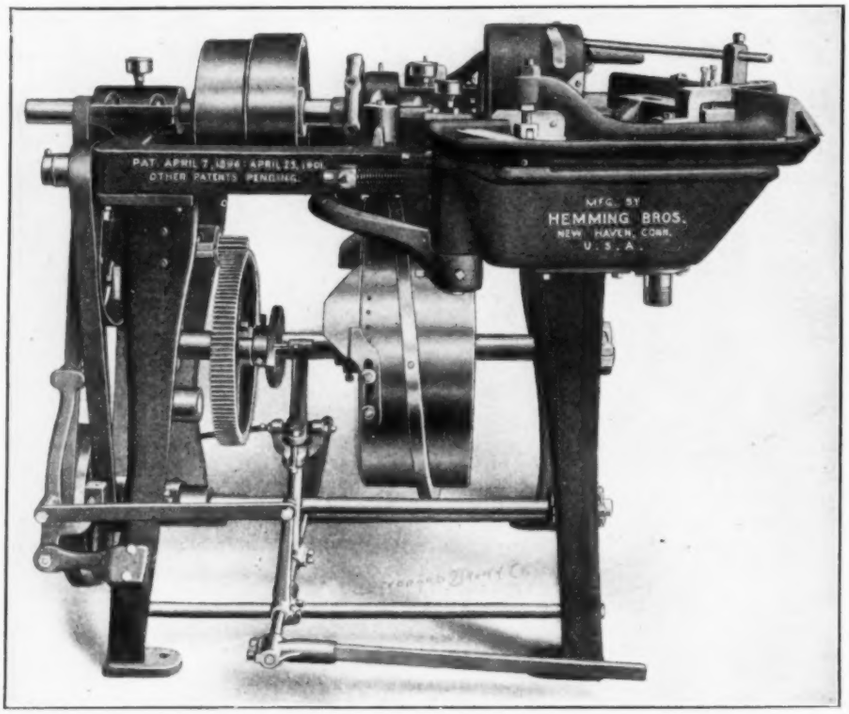


FIG. 4. GRINDING MACHINE FOR STEEL-HANDLE, STUB-TANG OR ROUND-TANG TABLE KNIVES

A gift of two hundred and fifty thousand dollars to the Sheffield scientific school of Yale University is announced. The building will be four stories.

The entire equipment will be new and will consist of modern appliances for assisting the student in studying those fundamental principles of applied science which are closely related to mechanical engineering, such as strength of materials, combustion of fuel in furnaces and in internal-combustion engines, the making of steam in boilers of different types, the using of saturated and superheated steam in engines or steam turbines, the artificial production of cold, the production, transmission and use of compressed air, purifying of water, transmission of power, and the problem of heating and ventilating.

A Vertical and Horizontal Milling Machine—A Lathe Improvement—Shaping Clutches

BY E. A. DIXIE

Fig. 1 shows an old Grant & Bogert milling machine which has been converted into a vertical and horizontal machine by removing the old outboard support and substituting the one shown at *A*. The drive is by means of the pulley *C* through the bevel gears to the vertical spindle. The bracket *A* is provided at *B* with an outboard support for the horizontal spindle.

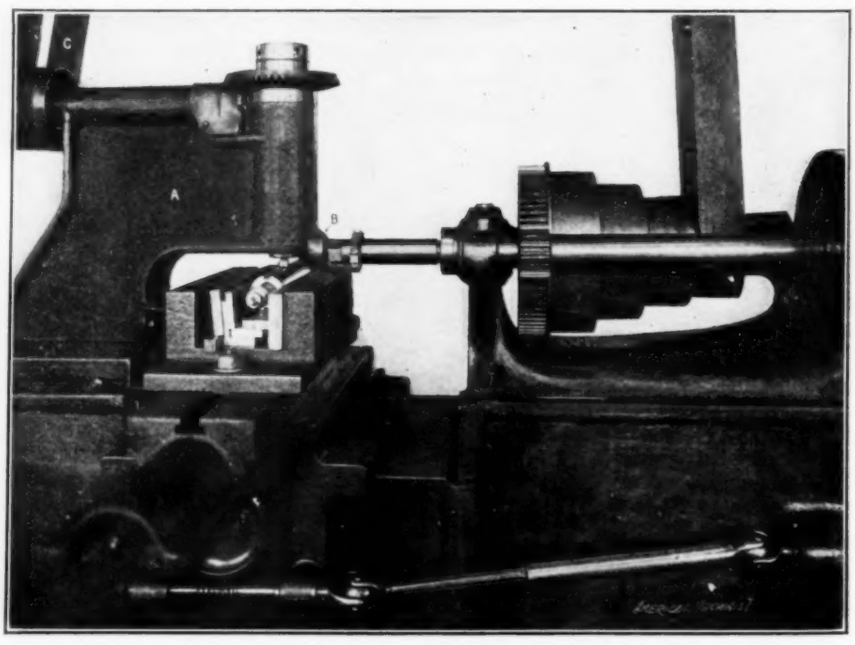


FIG. 1. GRANT & BOGART MILLING MACHINE WITH RECONSTRUCTED OUTBOARD SUPPORT

CORRECTED SPINDLE ADJUSTMENT FOR AN OLD STYLE LATHE

Fig. 2 shows the rear end of the spindle of an old-style lathe. As is well known the old-style lathe spindles were always adjusted forward. Usually the lower half of the rear box had an offset bracket cast in one piece with it and in the end of this was a set screw having lock nuts. This took care of the end wear and adjustment of the spindle. The lathe, part of which is shown in Fig. 2, was originally adjusted in this same way. It is a large lathe swinging in the neighborhood of six feet.

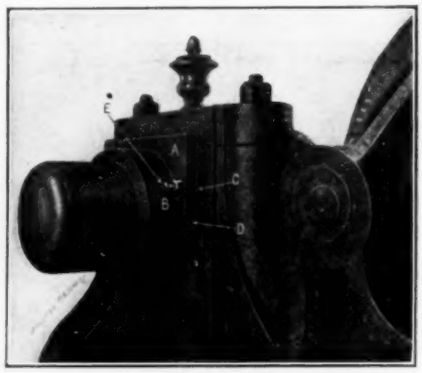


FIG. 2. END ADJUSTMENT ON LARGE LATHE SPINDLE

The flange of the spindle behind the

thread on the nose is of large diameter, quite large enough to take the thrust of the cut when turning or facing. New boxes were fitted to the rear end of the spindle. The upper box *C* had a flange half the thickness of that on the lower box *D*. A loose flange *A* about the same thickness as the flange *C* was made with two set screws *E*, one on each side. The back of this flange *A* bears against the flange *B* on the rear end of the spindle and tightening the set screws *E* against *C* forces the spindle backward, bringing the flange on the front of the spindle in contact with the front box. Since fixing the spindle in this way I am told that the lathe does as fine a job of facing and turning as any lathe in the town, which could not have been said of it before.

A Ratchet Shaping Fixture

Fig. 3 shows a ratchet-clutch shaping fixture. *C* is the body which is bored to receive a central post to which the clutch blanks *E* are attached. The right- and left-hand reversible master ratchet *B* is secured to this post and imparts vertical motion to the post. The worm gear *F* rotates the post and the master ratchet clutch. It is operated by the worm *A* at the other side of the machine. This worm is hand operated but power feed could easily be arranged. The thrust of the shaper tool is taken by the cast-iron V-bracket *D*. As the blank *E*, central post and master ratchet *B* rotate together the master ratchet rides up on a forming pin which causes the blank to follow the outline of the face of the master. It will be noticed that the master is made double right- and left-hand. This is to take care of both right- and left-hand clutches.

I saw these devices in the shops of the Pottstown Machine Company, Pottstown, Penn., builders of tapping and other special machinery.

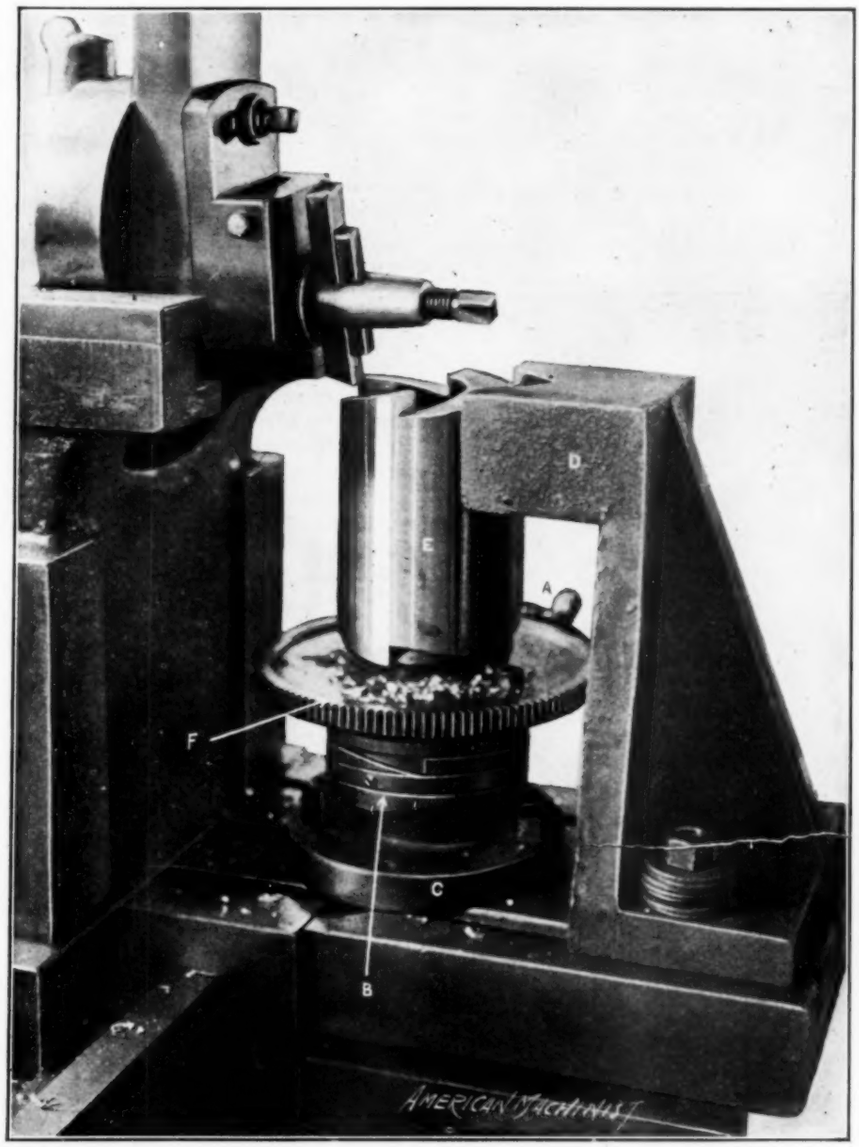


Fig. 3. Fixture for Shaping Right- and Left-hand Clutches

Grinding to a Mirror Finish

By J. H. Hollinger

The photograph shows a cast-iron disk 7 inches diameter, ¼ inch thick, which I ground to such a fine finish that it is almost impossible to detect any difference from a glass mirror; this I do not think is putting it too strong, as you will notice the reverse printing on the card, which clearly and accurately reflects in the disk. This work was done on a Landis No. 3 universal grinding machine, capacity 12x42 inches, the disk being held on a magnetic chuck and rotated at 75 revolutions per minute. The peripheral speed of the wheel was 6000 feet per minute, the wheel being grade 24, combination L, American make.

A Cast-iron Disk Ground to a Mirror Finish

I find that the mirror of classical antiquity was a thin disk of bronze, slightly convex on one side and polished. The very large number of mirrors still existing from antiquity shows that bronze was the regular material employed, the alloy known as speculum producing a very hard metal with great reflecting power. The characteristics of Greek art here referred to date from a little before 400 B. C. and last for some time after. I do not think this is a step backward, and I do not know whether it will be of any great commercial value, but it proves beyond doubt what a grinding machine is capable of producing if kept in the proper condition. In grinding work to a high polish it is essential that the wheel spindle shall have a good bearing and be adjusted very close; in fact, the wheel spindle should run almost metal to metal; the same applies to the work-carrying spindle bearings.

SEVERAL VARIETIES of EUROPEAN PYROMETERS

Their Operation and Application in the Heating of Steel

BY CHARLES E. FOSTER

It would not be expedient here to argue the need of pyrometers for the successful heat treatment of steel. The progressive manufacturer is already fully convinced of this, while the unbeliever will sooner or later be converted by the inevitable trouble that follows the use of "rule of thumb" methods.

It may, however, be profitable to consider the different types of pyrometers and their suitability to heat-treatment processes. Pyrometers are, like steels, good, bad or indifferent, as the case may be, and also like steels, the best service is generally given by the higher-priced article. The parallel between the steels and the instruments may be followed further, for each type of pyrometer has its own field of most suitable use.

FIG. 1. FERY RADIATION PYROMETER OUTFIT

The different types of pyrometers may be classified as follows: I, radiation; II, thermoelectric; III, resistance.

RADIATION PYROMETERS

Those in the first class work entirely at a distance from the hot body. They make the measurement either by the light intensity or the heat intensity of the radiation from the hot body. If the former they will be classed as "optical," while in the case of the latter they are called "total radiation" pyrometers.

Optical pyrometers, whatever their form, depend on the skill of the user in matching two light intensities and in some cases also involve color judgment as an added complication. While they can be of great value in the laboratory they are not easily adapted to factory use. They require the constant attention of the user and cannot be made in any sense automatic.

With the total radiation instruments, notably those of Prof. Charles Fery, these difficulties are not met. While they have all the advantages of the optical pyrometers in ease of pointing and working at a distance, they are capable of full or semi-automatic operation; that is to say, they do not depend for their accuracy on the skill of the user beyond his ability to read the temperature indicated by a pointer moving automatically over a direct reading scale.

The total radiation pyrometer depends, for its action, on the radiant heat given out by the furnace or other hot body. Of the total radiant energy only a very small part is apparent as visible light. Much more is in the form of invisible or "infra-red" radiation. This explains why the total radiation instrument can be made automatic in action; it has available much more energy than in the case of the optical instrument.

THE FERY PYROMETER

A very brief description will show the general principles employed by Prof. Fery. Fig. 1 shows the complete instrument in actual use. It will be seen that the operator having once pointed the telescope, need pay no further attention to it, but can study the pointer of the indicator as it moves over the scale.

In Fig. 2 a section of the telescope is shown on the right. The radiant heat from the hot body, both visible and invisible, is caught by the concave mirror *M* and reflected to a focus at *F*. There a portion of the focused energy heats one junction of a very small thermocouple. By means of the binding posts *T* a flexible cable and an indicating millivoltmeter, the electric current due to the heating of the thermocouple junction at *F*, causes a deflection of the millivoltmeter pointer over the scale. By suitable calibration this deflection is made to show directly the actual temperature of the furnace at which the telescope is pointed.

The pointing of the telescope is verified through the eye piece *E*, and the focusing is operated by the milled head *H;* the pinion *P* gearing with the rack *R*. The latter carries the mirror *M* backward and forward as the head *H* is turned. Suitable arrangements are made rendering the indications of the instrument independent of distance within certain well defined limits.

It will be at once obvious that if the indicating millivoltmeter is replaced by a recording instrument the whole outfit then becomes automatic, and once set up it will continue to record the temperature of whatever body or place it is pointed at.

MODIFIED INSTRUMENT

A recent modification of this instrument has been developed by Professor Fery, in which the sensitive thermocouple is replaced by a minute multi-metallic spiral. Fig. 3 shows this spiral much enlarged. It is composed of metals of different thermal coefficients of expansion so that, when heated, it tends to uncurl. The inner end of the spiral is

fixed to an adjustable support carried by the telescope casing, while the outer end carries a very light aluminum pointer.

In Fig. 4 is shown a section of the telescope with the spiral in place. The movement of the pointer *P* over the scale *D* is observed through the window *W*. This design provides an instrument which is self-contained, and for some purposes it is accordingly convenient. In Fig. 5 the instrument is viewed from the rear, and the scale can be clearly seen.

In contradistinction from the thermocouple, this spiral is sensitive to changes in the temperature of its surroundings. In the thermocouple type, Fig. 2, the "cold junction" of the thermocouple is quite close to the heated junction, so that the general heating up of the instrument in use affects both alike, and does not affect the reading.

With the spiral a rise in general temperature, due to continued use, will cause a movement of the pointer. For this reason a shield is mounted on the front of the telescope and is used to keep out heat while the pointer is set to zero. Then the shield is moved and the telescope

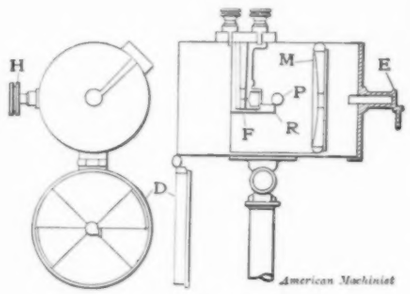


FIG. 2. SECTION OF TELESCOPE

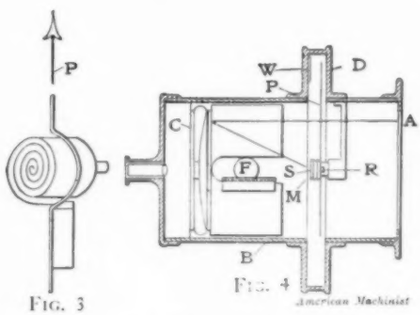


FIG. 3 FIG. 4

SPIRAL AND SECTION OF PYROMETER

pointed at the furnace. The temperature is read as soon as the pointer reaches an approximately steady reading and the shield is swung in position to close the telescope again.

The taking of isolated readings is very conveniently done with this spiral type, but for continued use, or for recording, the thermoelectric type is much to be preferred.

It will be seen that as no part of the pyrometer is ever heated to the actual temperature measured, the range of the instrument is capable of indefinite extension in the high-temperature field.

THERMOELECTRIC INSTRUMENTS

Coming to the second class of pyrometers, the thermoelectric type, the salient characteristic is that some portion of the pyrometer outfit must be heated to the actual temperature to be measured. This at once suggests that there will be definite high-temperature limits to the use of thermocouples, above which the active portion will be more or less rapidly destroyed.

The general principles of construction of the thermoelectric couple are well known and need not be discussed here. It suffices, in passing, to remark that the action depends upon the electromotive force set up when heat is applied to the

FIG. 5. FERY SPIRAL PYROMETER

junction of two different metals or alloys. The choice of the two metals or alloys determines the class of work for which a thermocouple is suited, and is the starting point in the design of thermoelectric pyrometers.

RARE-METAL THERMOCOUPLES

Thermocouples in which the wires or elements are of platinum and its alloys are frequently known as "rare-metal" instruments, while those employing cheaper metals or alloys are, for distinction, called "base metal" types.

The governing factor with the rare-metal instrument is the high cost of the platinum. This factor compels the use of thin wires in the thermocouple, consequently anything tending to attack the platinum and change its nature will quickly destroy the couple unless it is well protected. The limit of high temperature for the rare-metal elements is reached when we reach the temperature at which the protecting tube fails, and this is generally much below the melting point of the wires themselves.

The protecting tube cannot be of metal for high temperatures, but must be of refractory material, impervious to gases; it consequently requires careful handling to avoid breakage. Fig. 6 shows a typical indicating rare-metal outfit in which the thermocouple has a removable porcelain tube.

HIGH-RESISTANCE CIRCUIT

Another consequence of the small diameters of the platinum wires results

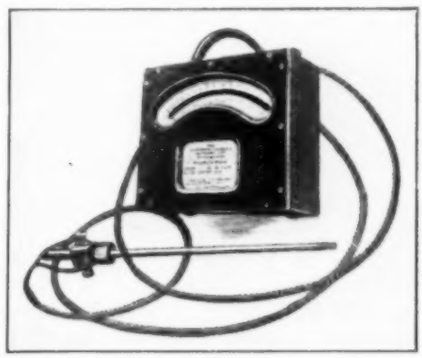


FIG. 6. RARE-METAL INDICATING PYROMETER OUTFIT

from their high electric resistance; and as the couple is inserted deeper into the furnace its resistance increases. Unless the rest of the circuit (leads or cable and indicator or recorder) is of resistance many times greater than that of the couple, this increase, due to deeper insertion, will produce a noticeable reduction in the temperature reading; the pyrometer will read low when deeply immersed.

In the earlier history of pyrometry the design of the millivoltmeter represented the great obstacle. It was only by suspending the moving parts of the instrument on a delicate wire or strip that sufficient sensibility could be obtained while employing the desired high electric resistance. This made all the indicators of two years back troublesome to handle.

Recent advances have removed these difficulties. A portable indicator is now made having the desired high resistance and at the same time the moving parts are carried on pivots, doing away with the need of accurate leveling in use, or clamping of coil when carrying. The instrument shown in Fig. 6 is of this improved type.

BASE-METAL THERMOCOUPLES

The substitution of cheaper metals in the place of platinum at once relieves the pyrometer designer from the embarrassment of cost of his materials. He can consequently use couple wires of large size and low resistance and further, by

suitable choice, can use alloys whose electromotive force is very much greater than that of the rare metals.

The thermocouple itself being of low resistance, the rest of the circuit can be low also. The force given by the couple being large, and the whole circuit of low resistance, the indicator need not be so delicate nor so expensive. In fact, at first sight, the base-metal proposition looks like a pyrometric millenium.

If the use is confined to medium temperatures, such as are met in the treatment of ordinary carbon steels, there are available alloys of great stability, but to attempt to measure really high temperatures as for high-speed steel hardening, involves the use of metals themselves of very high melting point and of much less reliability.

The base metals being cheap, and their proper temperature range comparatively low there is no need for refractory protecting tubes. The usual protection is a steel tube generally with some inner fire clay or other protection over the wires themselves. This makes the replacement of the couples a matter of small expense. Fig. 7 shows a typical base metal indicating outfit in which simplicity and strength are carried to the fullest extent. There is only one connection to be made in the circuit and that is made at the head of the thermo-couple by means of a non-reversible spring plug. The change from one thermo-couple to another is the work of only a few seconds.

Cold Junction Effect

The possible uses of thermocouples are of very wide extent. Their simplicity is a great point in their favor for shop use. But in applying the thermoelectric method theoretical considerations should not be wholly ignored. It has been stated above that a thermocouple depends for its action upon the electromotive force due to the heating of the junction between its two component wires. This junction, usually at the tip of the stem, is commonly called the "hot junction." There are, however, other junctions in the circuit.

The wires make connection at some point, with the rest of the circuit and here form two secondary thermoelectric couples. These two are generally termed collectively, the cold junctions. The force developed to move the indicator pointer over its scale depends on the difference in temperature between the hot and the cold junctions. Hence for accurate work the cold junction should be kept at a steady temperature. Here it is important to note that there is no particular virtue in keeping the cold junction particularly cold. It is steadiness, not coldness that is to be desired.

In practice the actual temperature of the cold junction is taken into account in the calibration of the indicator. Obviously, if the hot junction were brought to the same temperature as that of the cold junction there would be no current flowing in the circuit because the forces of the junctions would balance and oppose each other. Therefore, the indicator is so set that when disconnected from the thermocouple it points to the reading on the scale representing the average temperature of the cold junction.

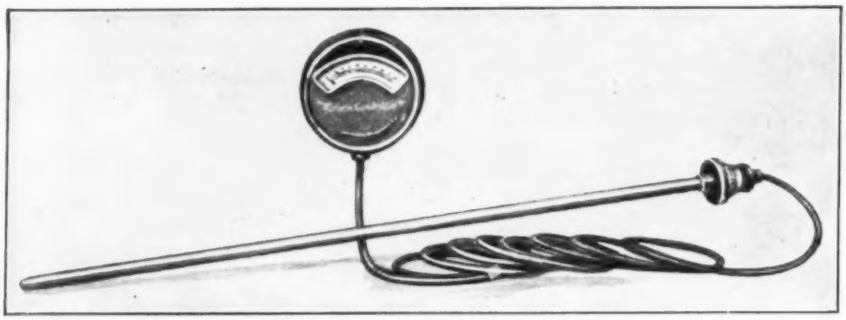


Fig. 7. Base-metal Indicating Pyrometer Outfit

Fig. 9. Portable Indicating Pyrometer Outfit

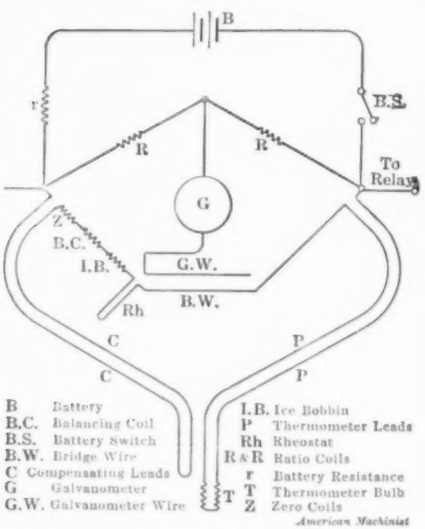


Fig. 8. Circuit Arrangement

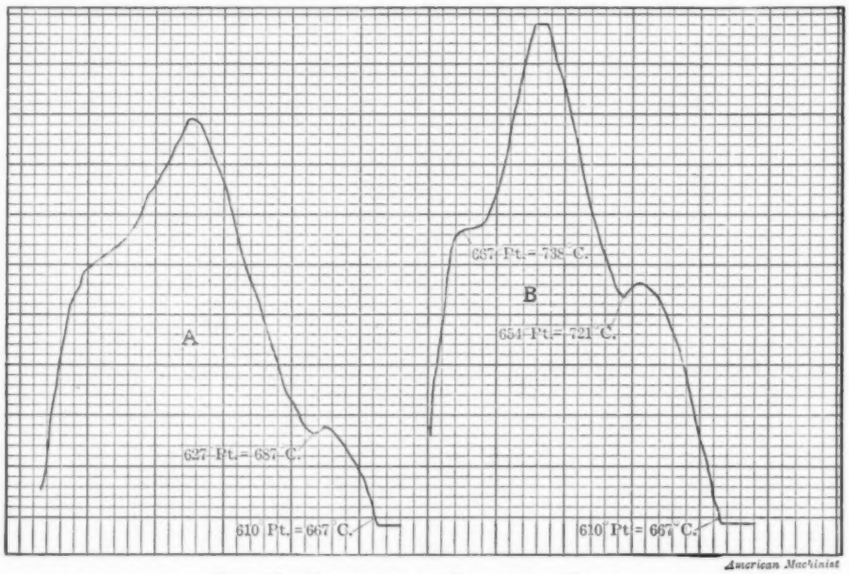


Fig. 10. Recalescent Points of Steel

Methods of Precision

The limitations with regard to cold-junction allowance mentioned above show the opening for another type of instrument for work where very fine discrimination is wanted. This is filled by the platinum resistance thermometer.

With all pure metals the electric resistance increases with a rise in temperature. Platinum is selected as the resistance material as it is the least alterable and, therefore, the most reliable. A great deal of work, both experimental and industrial, has been done with the platinum resistance thermometer and for temperatures below 1500 degrees Fahrenheit it is undoubtedly the instrument offering the finest temperature discrimination.

The sensitive portion of the apparatus is a coil of fine platinum wire. This is connected to an electrical circuit generally arranged on the principle of the Wheatstone bridge. For the information of those versed in electrical matters the diagram in Fig. 8 is given to show the essential circuit arrangements. As the method is arranged there, the only alteration of resistance in any part of the circuit that can affect the measurement is that due to a change in temperature of the platinum coil; all other changes are neutralized. There is, therefore, no difficulty or cause of error similar to the cold junction of the thermocouple.

Differences of temperature as small as half a degree can be easily detected by the use of resistance thermometers. While the measurement is literally one of electrical resistance, the instruments for industrial use are arranged to translate this direct into a temperature reading. A typical portable indicating outfit is shown in Fig. 9.

Recalescent Points

The resistance thermometer with a Callendar autographic recorder gives very accurate and beautiful charts of the recalescent points in steels. Fig. 10 is an example of this. It illustrates also the fact that the record chart may be arranged to cover a small temperature range on a very open scale. In this particular example a special temperature scale called the "Platinum," or "Pt" scale was used, but in regular work the standard scales, Centigrade or Fahrenheit are used.

Necessity for Careful Use

It is almost universal to find that the most accurate appliances require most care to preserve their valuable qualities. The platinum resistance thermometer is no exception. The bulb must be carefully protected and handled.

A moment's consideration will show how the resistance bulb compares with the thermo-couple in this respect. The heated portion of the thermo-couple will perhaps represent 1/40 of the total circuit resistance A mechanical distortion of this heated portion resulting in an increase in its resistance by ⅕ would thus make an increase in the total circuit reristance of ⅕ × 1/40, or half of one per cent. This would result in the pyrometer reading half of one per cent. low.

But in the case of the resistance bulb, damage causing an increase in its resistance by ⅕ would actually make the reading of the outfit high by that amount, or 20 per cent., because the arrangement is such that all other resistances in the circuit have no effect on the measurement, a change in the bulb alone affecting the reading. The chances of damage are, perhaps, greater in the case of the resistance thermometer because it generally employs finer wire than in the case of the thermocouple.

Suitable Applications

The foregoing remarks serve pretty well to indicate the proper fields of application for each type of pyrometer. The extreme high temperature field belongs clearly to the radiation pyrometer; the intermediate temperatures to the thermocouple, and the lowest, for fine discrimination, to the platinum resistance thermometer. Each type has a range wide enough to overlap the next type.

The measurement of temperatures attending the melting and pouring of steels can be done by radiation methods only. Heat treatment processes for hardening high-speed steels can be handled either by the radiation pyrometer or by the rare metal thermocouple. The use of base metals here is to be avoided as it can only result in failure, owing to the temperatures being too high.

Metal or salt baths for heating steel before quenching can be best controlled by the use of thermocouples. If the work requires accuracy, these should be rare metal, carefully installed and protected.

Annealing temperatures also belong to the field of the thermocouple and here the base-metal instrument shows to good advantage. It is robust, sufficiently accurate and being worked well within its temperature limits, will give long life to the outfit.

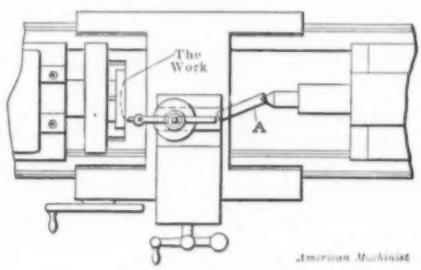
Processes where the material for treatment passes more or less continuously through a furnace cannot be well controlled by any thermocouple inserted in the furnace. The relation between the temperature as measured by the thermocouple and that of the material as it issues from the furnace will be a variable one depending on the time the pieces are heated. Here the radiation method is used to advantage even though the temperatures may range within the limit of the other types. It is worth noting here that radiation pyrometers can be scaled to read as low as 600 degrees Fahrenheit, for instance the Fery standard type has been frequently made with a range from 600 to 1800 degrees Fahrenheit. By means of the diaphragm the second range is then from 1600 to 3200 degrees Fahrenheit.

In conclusion it must be urged upon those who use any type of pyrometer, that the first essential is to use the proper kind of instrument, and the second, to accord that instrument sufficient care and attention to enable it to give good and reliable service.

Turning Concave Surfaces, Drilling Large Holes without Chatter

By Charles Tucker

The line cut shows a way of turning a concave surface on the lathe. *A* is equal to the length of the radius of the curve to be turned. One end of it is centered and bears on the center, the other end comes in contact with the end of the tool. As the tool is fed across the work the bar *A* swings in the arc of a circle and this motion is reproduced on the face of the work. To drill large holes nice and clean from the start without jumping or



Concave Turning

chattering in the least, take a small piece of old rag or waste about the size of the end of the drill, place it under the point of the drill, then drill through the rag or waste. The same may be used to a great advantage in countersinking work which requires a nice clean finish. By using small pieces of rag or waste there is no danger of catching one's fingers.

From statistics published in the German press covering aërial vessels available to various European governments, it is noted that Germany possesses 14 dirigibles of six different models and 5 aëroplanes. France has seven dirigibles and 29 aëroplanes; Italy, three dirigibles and seven aëroplanes; Russia, three dirigibles and six aëroplanes; Austria, two dirigibles and four aëroplanes; England, two dirigibles and two aëroplanes; and Spain, one dirigible and three aëroplanes. Altogether, European nations have 32 dirigibles and 56 aëroplanes that are presumed to be available for service.

It is also reported that the first airship for the British navy, which is now being built, will be the largest vessel of the kind in existence. It will be over 500 feet in length and driven by two motors of 200 horsepower each which will be capable of driving the vessel in still air at the rate of 45 miles an hour. Its nominal lifting power is rated at 20 tons, although it is expected its usual load will not exceed five tons.

A Tool Designing System That Works Well

The tool-designing department of the Thomas Motor Car Company has a very interesting system in connection with the making of new tools.

When a new fixture is to be made, the tool desired is first sketched in perspective, as shown in Fig. 1, three sketches being made by the use of two sheets of carbon paper underneath. One of these is on tissue paper so that blueprint can be made for it, the other carbon goes to the toolmaker, and the original pencil copy is retained for the file in the tool designer's room.

The next operation is to make a pencil and one carbon copy of all parts to be finished on milling machines or shapers. Then the same thing is done with the lathe or grinding part, a single carbon copy being also made in this case.

All forging or special parts are then detailed on a separate sheet and two copies are made by the use of carbon paper.

All of the sheets are given the tool sketch numbers and entered in the tool record. Then everything is checked and the number of the operation for which the tool is made is placed on the sketch.

A blueprint is made from the tissue copy of the perspective sketch and sent to the tool stores, or tool crib as it is sometimes called, so that the man in charge can always have a means of knowing what any tool looks like. This is extremely convenient in case a tool has accidentally been put in the wrong place, as the sketch gives a much better clue than any description possibly could.

Every sketch has to be O. K'd by the chief tool designer, the tool-room foreman and the superintendent, after which they are sent to the cost department for orders. When these are received they are turned over to the tool room and the tool is made.

The operation that each piece of work has to undergo is decided in this department and is then entered on an operation sheet, and the tool stamped accordingly, with the tool-sketch number and

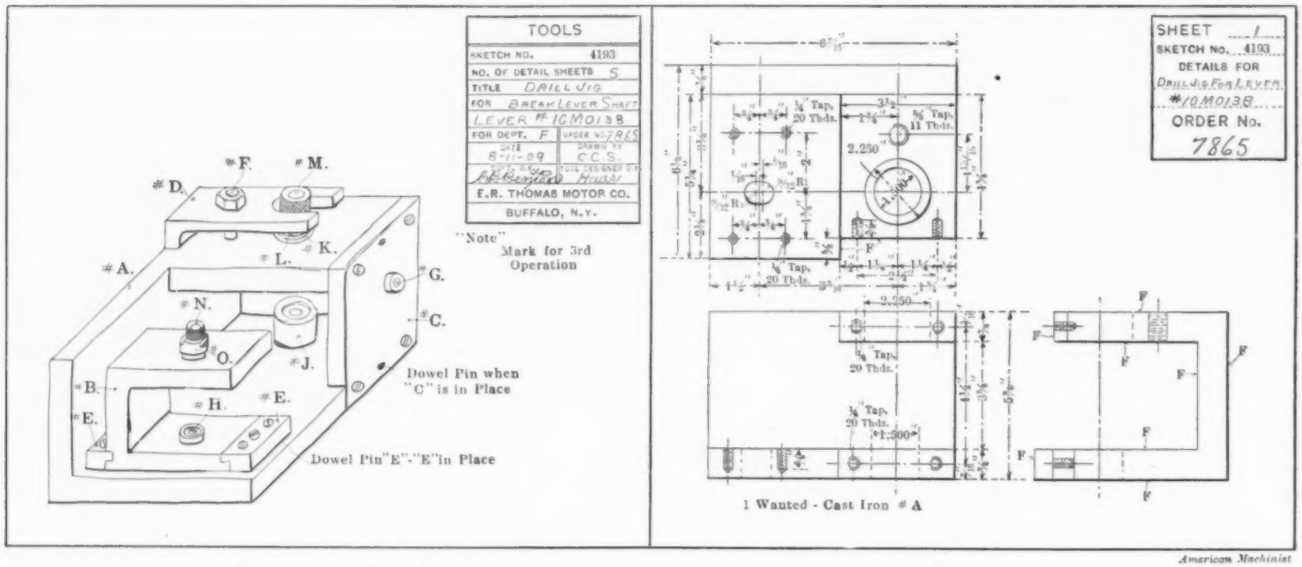


FIG. 1. SKETCH OF COMPLETE JIG

FIG. 2. DETAILS OF THE BODY

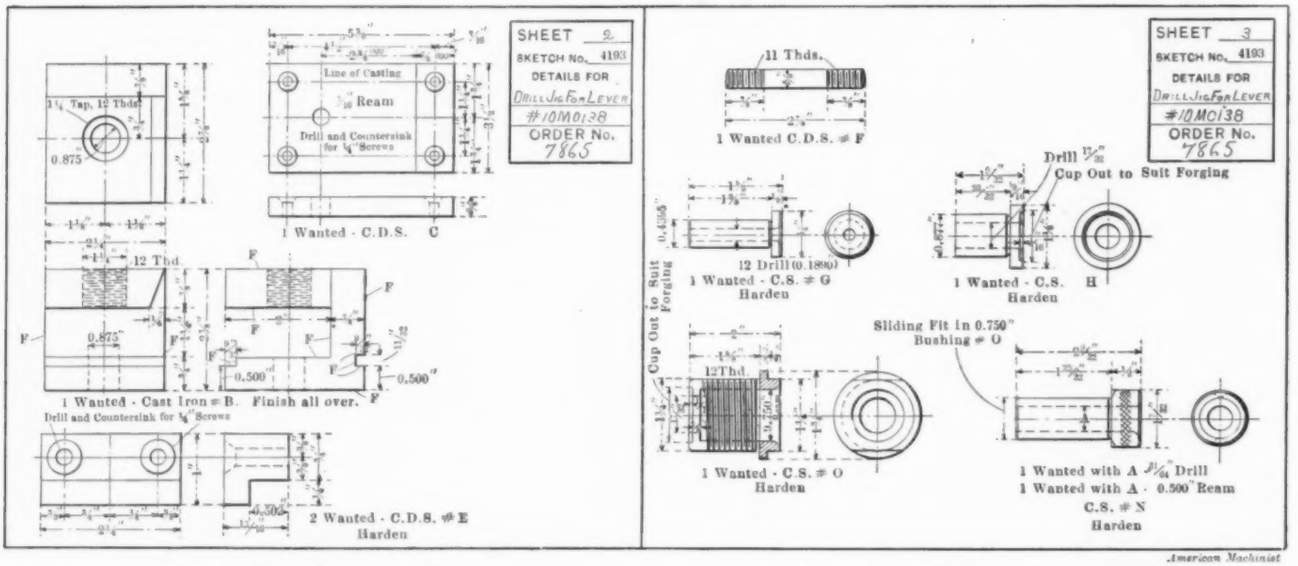

SHEET 2
SKETCH NO. 4193
DETAILS FOR DRILL JIG FOR LEVER #10M0138
ORDER No. 7865
1 Wanted - C.D.S. C
1 Wanted - Cast Iron # B. Finish all over.
2 Wanted - C.D.S. # E Harden
SHEET 3
SKETCH NO. 4193
DETAILS FOR DRILL JIG FOR LEVER #10M0138
ORDER No. 7865
1 Wanted C.D.S. # F
1 Wanted - C.S. # G Harden
1 Wanted - C.S. H Harden
1 Wanted - C.S. # O Harden
1 Wanted with A 21/64" Drill
1 Wanted with A - 0.500" Ream
C.S. # N Harden
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FIG. 3. THE PLATE AND SLIDE

FIG. 4. PARTS TURNED AND GROUND

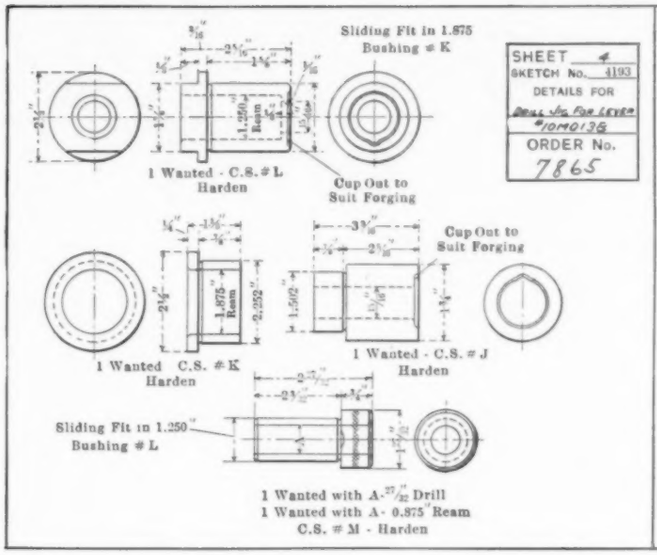

Sliding Fit in 1.875 Bushing # K
1 Wanted - C.S. # L Harden
Cup Out to Suit Forging
Cup Out to Suit Forging
1 Wanted C.S. # K Harden
1 Wanted - C.S. # J Harden
Sliding Fit in 1.250 Bushing # L
1 Wanted with A- 27/32" Drill
1 Wanted with A- 0.875" Ream
C.S. # M - Harden
SHEET 4
SKETCH No. 4193
DETAILS FOR
Drill Jig For Lever
#1040138
ORDER No.
7865

FIG. 5. THE HARDENED BUSHINGS

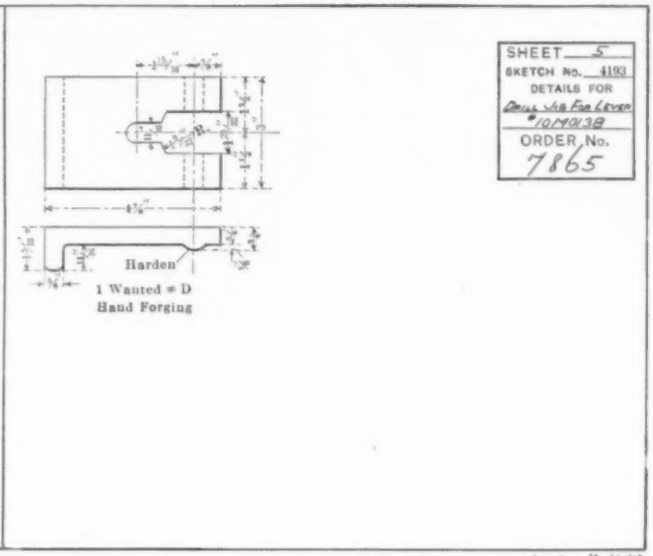


FIG. 6. A FORGING

the number of the operation. When the tool has been completed it is sent to the tool inspector, checked up with the tool sketch, and when it has received his O. K., it is sent to the tool storage and is ready for use.

STANDARD JIG PARTS

The chief tool designer of the Thomas Motor Car Company, Louis Haas, has developed an interesting system of standard jig parts, which are shown in the accompanying tables. These include channels, angles, bricks, plates, square and

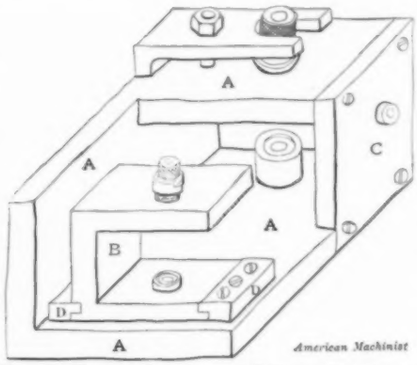


FIG. 7 USING STANDARD FIXTURE SHAPES

bar stock, round plates, faceplates and milling-fixture plates. The proportions and range of sizes are the result of a wide experience in tool designing and there are surprisingly few jigs and fixtures which cannot be built up from parts already in stock as outlined by these standards. It is interesting to note that for such jig details as handles, thumb nuts, etc., Mr. Haas has adopted the standards recommended by the AMERICAN MACHINIST'S *Handbook* and uses them exclusively on all his fixtures.

As an example of the way in which

Tap Drill List

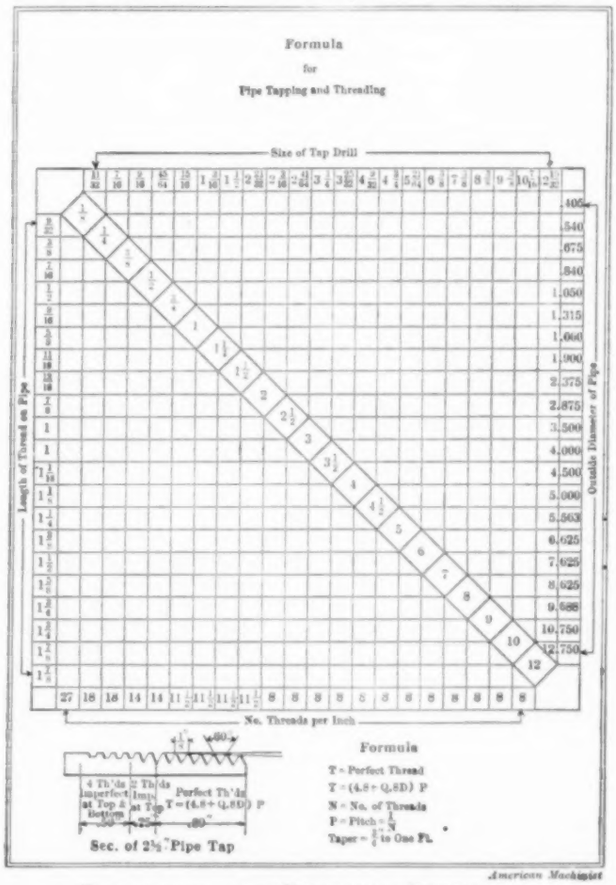
Size	Th'd	Body Drill	Tap Drill for: Cast Iron Mall. Iron	Alumn. Brass	St. Forging St. Casting
4 - 36	V	32	43	44	42
4 - 40	V	32	42	43	42
6 - 32	V	27	33	34	32
8 - 32	V	18	28	29	28
10 - 24	V	9	24	25	23
10 - 32	V	9	21	22	20
12 - 24	V	1	16	17	15
14 - 20	V		11	12	10
14 - 24	V		7	8	6
1/4 - 20	U.S.S.		10	11	9
1/4 - 24	U.S.S.		5	6	4
1/4 - 28	Alum.		4	5	3
1/4 - 32	U.S.S.		3	4	
5/16 - 18	U.S.S.		D	C	
5/16 - 24	Alum.			G	H
5/16 - 32	V		J	1	
3/8 - 16	U.S.S.		N		
3/8 - 18	U.S.S.		O		O
3/8 - 24	Alum.			P	Q
7/16 - 14	U.S.S.		U	S	U
7/16 - 20	Alum.		W		
7/16 - 24	U.S.S.			W	X
1/2 - 12	U.S.S.		Z		

Size	Th'd	Body Drill	Tap Drill for: Cast Iron Mall. Iron	Alumn. Brass	St. Forging St. Casting
1/2 - 13	U.S.S.			Z	
1/2 - 18	F.L.				
1/2 - 20	Alum.				16
1/2 - 30	F.L.				
9/16 - 12	U.S.S.				
9/16 - 18	Alum.				
9/16 - 20	F.L.				
5/8 - 24	U.S.S.				
5/8 - 11	U.S.S.				
5/8 - 18	Alum.				
5/8 - 16	Alum.				
5/8 - 10	U.S.S.				
5/8 - 16	Alum.				
5/8 - 18	U.S.S.				
5/8 - 9	U.S.S.				
5/8 - 12	U.S.S.				
5/8 - 14	Alum.				
1 - 8	U.S.S.	1 7/64			
1 - 12	U.S.S.	1 1/64			
1 - 14	Alum.	1 1/64			
1 - 16	U.S.S.	1 1/64			
1 - 18	U.S.S.	1 1/64			

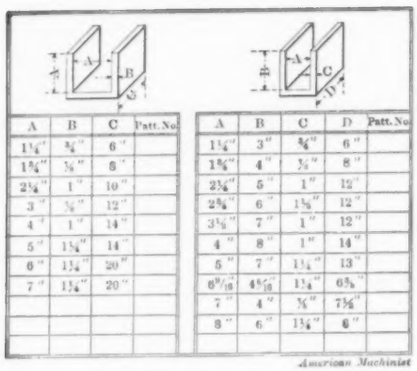
All Taps over 1 Inch should have the Hole Reamed to Proper Size before Tapping, allowing the following variations in Size of Hole for different Materials with relation to the Number of Threads

No. of Threads Per 1"	Th'd	Cast Iron Mall. Iron	Alumn. Brass	St. Forging St. Casting
8	U.S.S.	-.14298	-.15798	-.14298
9	U.S.S.	-.12433	-.13533	-.11030
10	U.S.S.	-.10990	-.12490	-.10990
11	U.S.S.	-.10750	-.11500	-.10009
12	U.S.S.	-.10006	-.10425	-.09930
13	U.S.S.	-.08492	-.09492	-.07992
14	U.S.S.	-.08280	-.08780	-.07780
16	U.S.S.	-.07218	-.07718	-.06718
18	U.S.S.	-.06616	-.07116	-.06216
20	U.S.S.	-.05595	-.05995	-.05295
24	U.S.S.	-.04412	-.04612	-.04012
28	U.S.S.	-.04039	-.04139	-.03639
30	U.S.S.	-.03930	-.04230	-.03530
32	U.S.S.	-.03659	-.04059	-.03259

TAP DRILLS FOR VARIOUS METALS



PIPE-TAPPING AND THREADING FORMULA



A	B	C	Patt. No.
1¼"	¾"	6"	
1⅝"	⅜"	8"	
2¼"	1"	10"	
3"	⅝"	12"	
4"	1"	14"	
5"	1¼"	14"	
6"	1¼"	20"	
7"	1¼"	20"	

A	B	C	D	Patt. No.
1¼"	3"	⅝"	6"	
1⅝"	4"	¾"	8"	
2⅜"	5"	1"	12"	
2⅝"	6"	1⅜"	12"	
3⅛"	7"	1"	12"	
4"	8"	1"	14"	
5"	7"	1¼"	13"	
6 9/16"	4 5/16"	1¼"	6⅜"	
7"	4"	⅜"	7⅜"	
8"	6"	1⅜"	6"	

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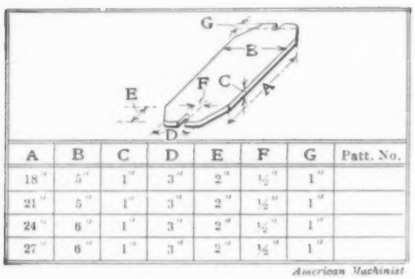
FIG. 8. STANDARD CHANNELS



A	B	C	D	E	F	G	Patt. No.
18"	5"	1"	3"	2"	½"	1"	
21"	5"	1"	3"	2"	½"	1"	
24"	6"	1"	3"	2"	½"	1"	
27"	6"	1"	3"	2"	½"	1"	

American Machinist

FIG. 12. MILLING FIXTURE

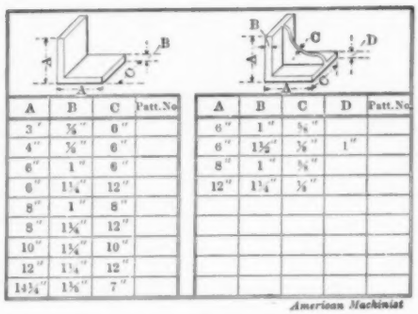
these standard castings are used, we may refer back to Fig. 7, which shows quite an elaborate drilling fixture. This is made up principally of two standard channels, a plate and standard bushings.

The large channel *A A A A*, has half of one side cut out and both sides planed down to receive the standard plate *C*, which ties the sides of the channel together and also carries a drill bushing, as shown. A smaller channel *B*, is planed to slide under the gibs *D D* and allow the bushings to be adjusted as desired with reference to those carried in *A*. Almost innumerable combinations can be made in this way, and this also gives another example of the perspective sketching used in connection with their system of tools.

Figs. 8 to 12 show a variety of the standards used and give the dimensions which have been proved most useful in this line of work. These proportions can be varied to suit any conditions.

They have a useful method of framing standard tables and blueprints for use in the tool-designing department and elsewhere. This is clearly shown in Fig. 13. It consists of a substantial frame, with glass, and a solid board back which is held in place by the four clips or buttons shown. These are hung on the walls at a convenient hight, so as to be readily consulted, the print can be kept clean and can be readily removed for alterations or additions, or to be replaced by new and improved tables. The time saved by the men over that used in going through a file of blueprints will soon pay for all the frames required.

Two of the interesting tables in use, which originated in this shop, although



A	B	C	Patt. No.
3"	⅜"	6"	
4"	⅜"	6"	
6"	1"	6"	
6"	1¼"	12"	
8"	1"	8"	
8"	1⅜"	12"	
10"	1¾"	10"	
12"	1¾"	12"	
14¾"	1⅜"	7"	

A	B	C	D	Patt. No.
6"	1"	⅝"		
6"	1½"	⅜"	1"	
8"	1"	⅝"		
12"	1¼"	⅜"		

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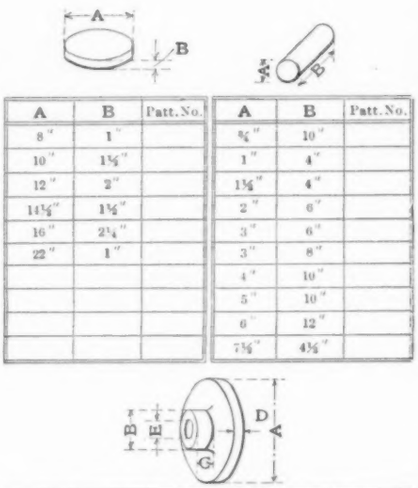
FIG. 9. STANDARD ANGLES



A	B	Patt. No.
8"	1"	
10"	1⅝"	
12"	2"	
14½"	1½"	
16"	2¼"	
22"	1"	

A	B	Patt. No.
⅝"	10"	
1"	4"	
1⅛"	4"	
2"	6"	
3"	6"	
3"	8"	
4"	10"	
5"	10"	
6"	12"	
7⅛"	4¾"	

A	B	C	D	E	Patt. No.
10"	3¾"	1 5/16"	1⅝"	2"	
12¼"	4¼"	4⅜"	1⅛"	Solid	
14"	3¾"	1 5/16"	1⅜"	2"	
16⅜"	12½"	½"	1⅜"	Solid	
11⅝"	3¾"	2½"	1"	Solid	
18½"	4¾"	2"	⅞"	Solid	

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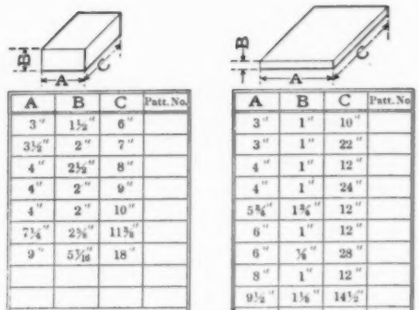
FIG. 10. ROUND PLATES, BAR STOCK AND FACEPLATES



A	B	C	Patt. No.
3"	1½"	6"	
3½"	2"	7"	
4"	2½"	8"	
4"	2"	9"	
4"	2"	10"	
7¼"	2⅜"	11⅜"	
9"	5 5/16"	18"	

A	B	Patt. No.
1"	6"	
1⅝"	10"	
2"	10"	
2½"	12"	
3"	12"	
4"	12"	
5"	12"	

A	B	C	Patt. No.
3"	1"	10"	
3"	1"	22"	
4"	1"	12"	
4"	1"	24"	
5⅜"	1⅜"	12"	
6"	1"	12"	
6"	⅞"	28"	
8"	1"	12"	
9½"	1⅛"	14½"	
10"	1⅛"	24"	
12"	1⅛"	12	
13"	1"	29"	
12"	1"	24"	
6"	1¼"	34"	
6"	1⅛"	23½"	
12"	1⅛"	36"	
13"	1⅛"	30"	
7⅜"	1⅛"	49"	
14"	1"	14"	
10"	1"	16"	
18"	1 1/16"	18"	
12"	1⅜"	12"	
20"	11/16"	20"	
10"	1⅜"	16⅜"	

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FIG. 11. BRICKS, PLATES AND SQUARE STOCK

Mr. Buxton modestly disclaims originality in the method of arranging the pipe table, are also shown herewith.

Statistics covering the production of motor cars during 1909, as compiled by the Association of Licensed Automobile Manufacturers, seem to justify the tall estimates made at the beginning of that year. The figures indicate that the licensees under the Selden patent alone made 94,891. This is an increase of 130 per cent. over the 1908 production by the licensed makers, during which year 40,379 cars were built. To show the phenomenal growth of the automobile industry it is pointed out that the licensed product in 1903 was only 10,576 cars, 29,320 in 1906 and 34,568 in 1907. The increased production in the shops not licensed under the Selden patent shows just as phenomenal growth.

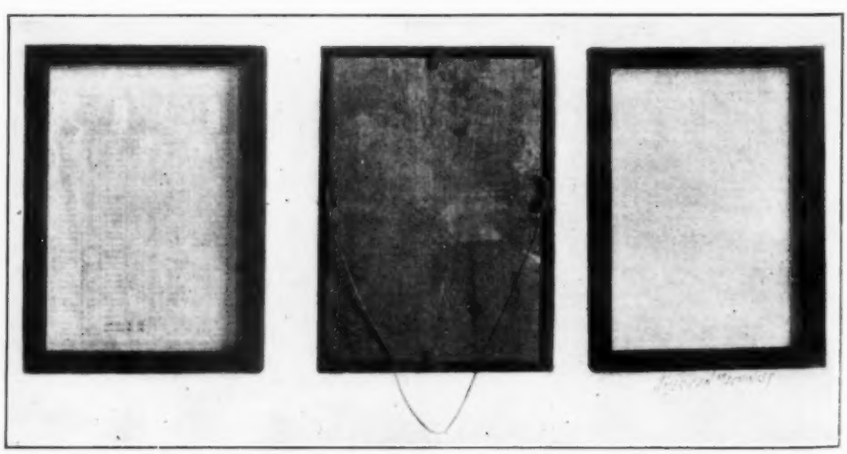


FIG. 13. FRAMES FOR STANDARD TABLES

Old Spanish Gun Boring Mills

By S. B. Redfield

In the accompanying halftones are reproduced some old drawings, which, to the best of our knowledge, represent different methods of boring cannon as employed in Spain in the early 1800s.

As will be noticed in each case, the power was supplied by horses traveling around a circular track. Fig. 1 shows a vertical boring mill, in which the boring tool revolves, while the work is supported in guides overhead, the necessary pressure for feeding being supplied by the weight of the work and the supporting cradle; this, in all probability, being partly counterbalanced.

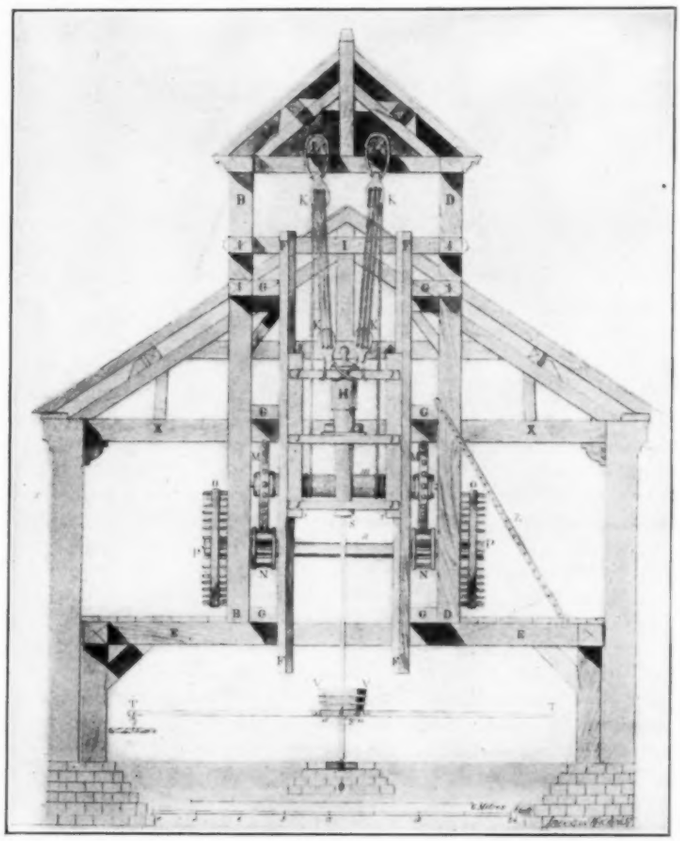


FIG. 1. AN OLD SPANISH VERTICAL GUN-BORING MILL. REVOLVING TOOL

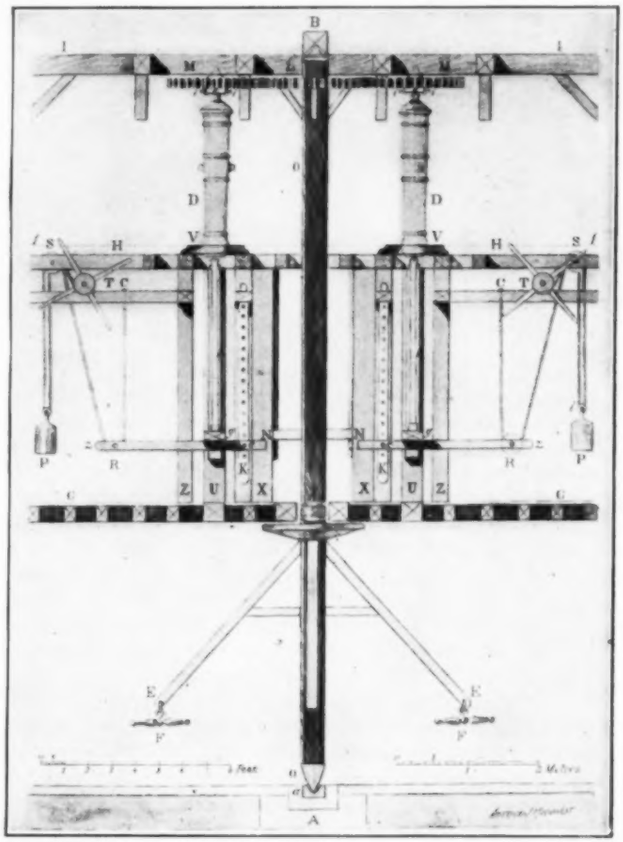


FIG. 2. OLD SPANISH QUADRUPLE GUN-BORING MILL. REVOLVING WORK

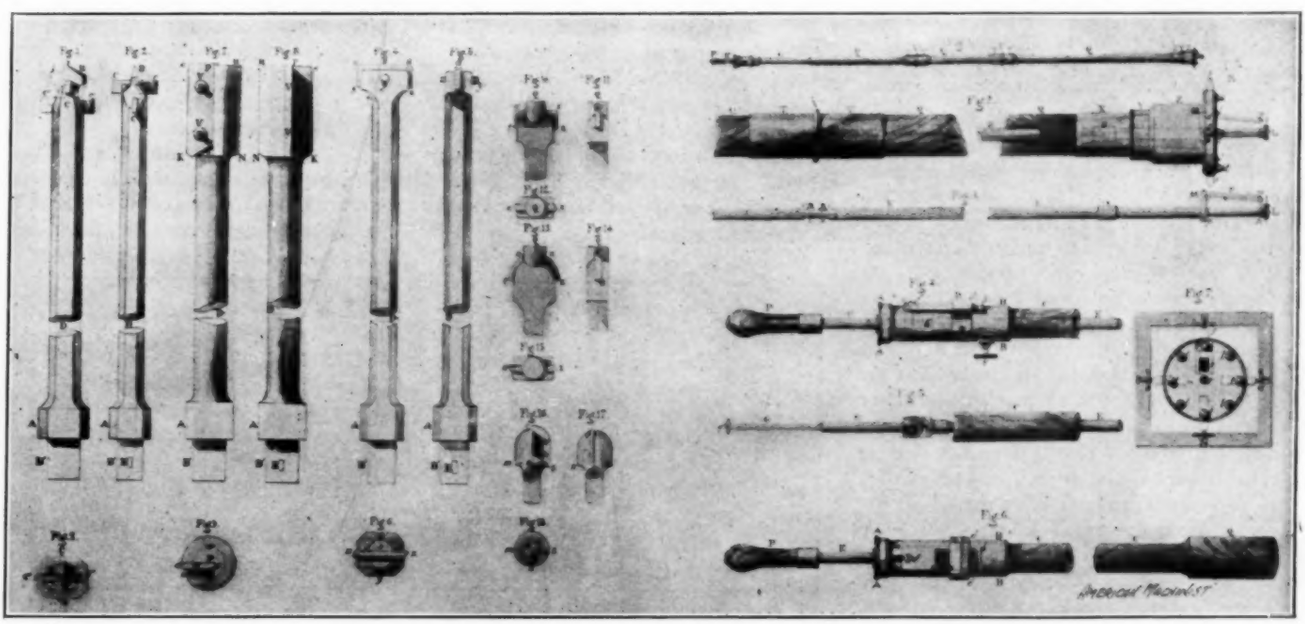


FIG. 3. OLD SPANISH GUN-BORING TOOLS AND REAMERS ON LEFT. GAGING INSTRUMENTS ON RIGHT. GUN BORE ABOUT 2 INCHES

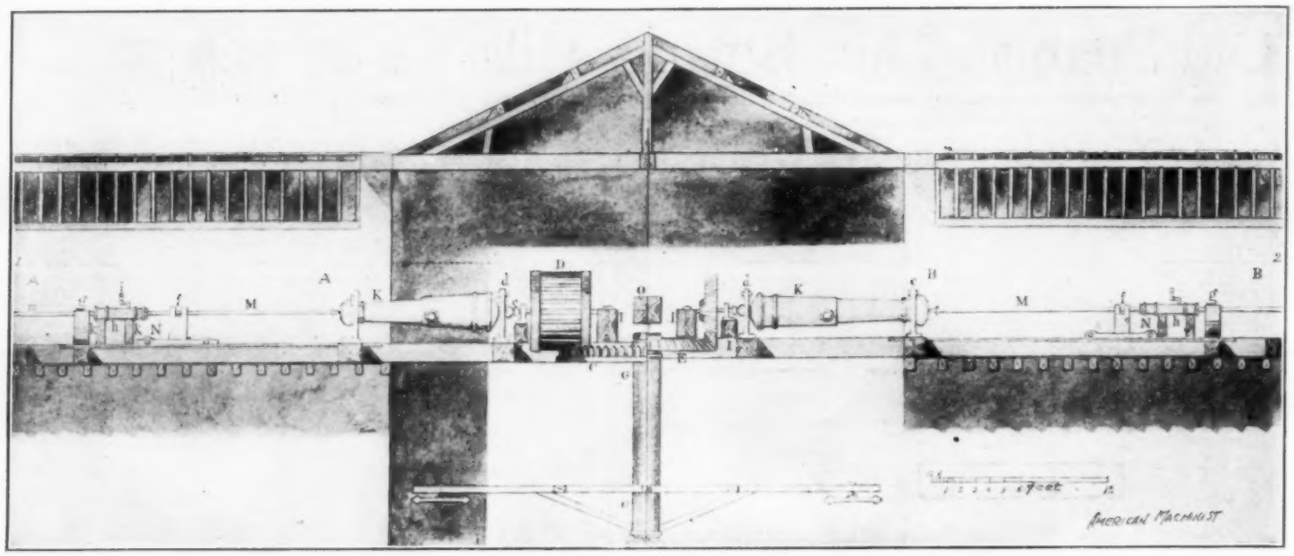


FIG. 4. OLD SPANISH HORIZONTAL GUN-BORING MILLS. REVOLVING WORK

In Fig. 2 is shown a somewhat improved method of working. In that case four cannon were bored at once, these being rotated by four gears meshing with the central driving gear, which in turn was driven by four horses traveling in a circular track underneath. The lower ends of the cannon being bored were kept central by wooden centering blocks, *V*, while the upward feed of the boring bar was supplied by the weights *P*, acting on the two horizontal levers *Z*. As seen, these horizontal levers could be lifted up at the fulcrum end, so that the swinging arc would be so small as not to interfere with the straightness of the bore.

Fig. 4 also shows a somewhat improved style of mill, where the work is horizontal and is also made to revolve while the boring bar is fed into the work by a crank, gearing and rack. This illustration seems to show two different mills, as the one on the left includes wooden gearing of the crown type, while the one on the right employs bevel gears, although it is doubtful whether the material is cast iron or wood.

Fig. 3 shows, in the left half, what should be the most interesting side of these old methods; that is, the boring tools and reamers and it is surprising to note how close they are to some modern practice in this line. It will be seen that the boring tool represented in the two drawings at the left end of Fig. 3 is provided with several cutters. The first, or centering cutter is of the smallest diameter, while it is followed up by an inserted cutter at right angles to this and of slightly greater boring diameter. Back of this again is another inserted cutter parallel to the first cutting edge and of the maximum diameter. The boring tool shown by the two drawings at the right of this group is evidently a finishing tool, while the two drawings between represent a reamer. In the center are the heads of various piloted boring tools, all of these tools having inserted cutters. The "cannon drill" is also in evidence.

The right-hand half of Fig. 3 shows the instruments used for gaging the accuracy of the work done, being a crude form of the star gage now in use. For these drawings we are indebted to Walter L. Clark, vice-president of the Niles-Bement-Pond Company, New York City.

A Holder for Flat Head Machine Screws

BY CHARLES EISLER

The holding of small work is often much more difficult than doing it after it is in place on the machine. This is particularly true of small screws and I show herewith a very handy screw holder that every toolmaker ought to have, as it is useful every day in tool and die making, or in any tool room.

I made the screw holder shown in Figs. 1 and 2, especially for flat-head screws, and after having it in use for a while, it proved to be just as useful for round and fillister-head screws. The cuts are so plain that it does not require much of an explanation. In operation it is very quick and the simplest of all the screw-filing fixtures I have as yet seen.

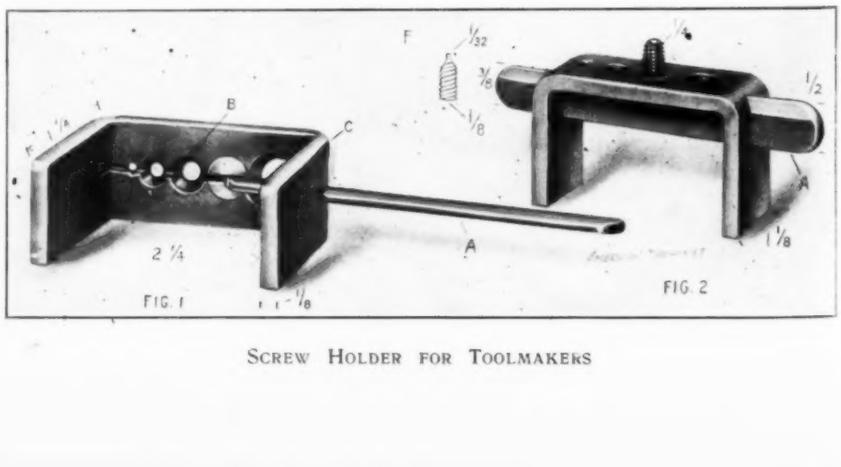
In Fig. 1 is shown the bottom of the screw holder, with a ¼-inch flat-head screw inserted, and Fig. 2 shows it ready for filing, threading or grinding. After the screw is inserted all that is necessary to do is to lock the key *A* without any hammering, as shown in Fig. 2, and it is ready to put in the vise and use.

It can be used for from ⅛- to ⅜-inch screws and all the holes are countersunk, as shown at *B*, Fig. 1, to allow the die to cut very close to the head of the screw.

Round- and fillister-head screws can be threaded by having the key *A* about 7/32 inch narrower than the one used for flat-head screws, and it will then fit any standard screws from ¼ to ⅜ inch.

The key *A* was made of tool steel and hardened, and the frame *C* of cold-rolled steel, and pack hardened.

The cost of a device of this kind is very low indeed and not worth talking about when its usefulness and time-saving qualities are considered.



SCREW HOLDER FOR TOOLMAKERS

LETTERS · FROM · PRACTICAL · MEN

Concerning the Details of making things in machine shops, from the first sketch to the sale

Tools for Ball-seats and Ball-ends

The tool shown at Fig. 1 was devised for use in the turret lathe to finish-form the spherical ball seat in a machine-steel piece of the general outline and dimensions of *D*, Fig. 1; these pieces were wanted in large quantities, the requirements being that the seat be smooth and free from ridges, and truly spherical in shape.

For finishing these seats the ordinary type of nose cutter had been tried, the work from these tools not being up to requirements, also the cutters being difficult to sharpen, and requiring a deal of hard work to make, some thinking was done to devise a cutter that could be mechanically and cheaply made.

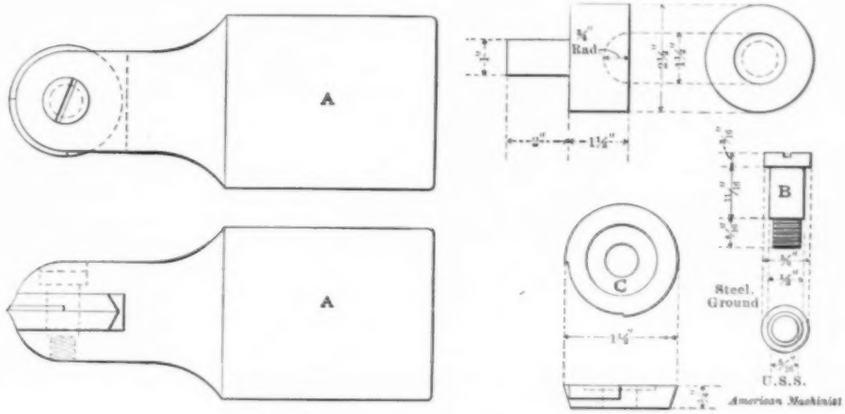


FIG. 1. THE BALL-SEAT TOOL

The tool ultimately evolved for the job, consisting of four parts, the body *A*, two cutters *C* and a locking pin *B*, is shown in Fig. 1. *A* is turned on one end to fit the turret, the other end is about 5/32 inch smaller than the diameter of the ball seat, the end rounded approximately spherical. A slot is milled through this end exactly central. The cutters *C* are tool steel hardened and ground all over, the largest diameter of the cone being that of the finished seat, and the thickness half the slot width, so that, when assembled face to face on the locking pin *B* (as shown in assembly view), their largest diameters coincide; they are a snug fit in the slot, and the cutting edges make a perfect joint on the center line of the tool.

Enough of the circumference for one-quarter of each cutter is cleared away as shown in the detail, to clear the cutting edge of the opposite cutter, and they are set to slightly overlap each other to avoid leaving a pip in the work. As the cutting edges wear, the worn portion is cleared away and the cutters given a quarter turn; thus three fresh cutting edges can be presented to the work before the cutters are worn out. No attempt is made to sharpen when dull, as they lose size in so doing, and they are cheaply made in lots of a dozen or more at a time. The cutters are held snugly in position by the locking pin *B* drawing the two ends of the body together, providing enough friction to prevent them turning under the pressure of the cut.

A BALL-END FORMING TOOL

A novel tool for forming ball ends on shafts used in the same shop is shown at *A*, Fig. 2, for a shaft end of about the shape and general dimensions of *C*, Fig. 2, the parallel and taper portions being finished and the ball roughed at a previous operation. The rig consists of but two parts, the tool proper *A* and the angle bracket *B* for holding it. The tool *A* is a piece of flat tool steel, with a parallel hole the diameter of the ball end ground in, and having the end cleared out to just clear the neck of the shaft. It is provided with two tapped holes to match the clearance holes in *B*. The bracket *B* is an L-shaped casting tongued on the under side to fit the tool post T-slot (so that it can be bolted firmly to the compound rest), and with its furthermost vertical face grooved out to the width of the tool *A*, and of the correct hight, so that when tool *A* is secured to it by the cap screws, the ball outline will be on the center line of the lathe.

In use the compound rest is swung round parallel with the cross-slide; when thus set, the cutting face of the tool is square with the cross-slide in both directions. The shaft is driven by a four-jaw universal chuck, and supported as suggested in the sketch close up to the tool by the steady rest. The tool is fed in by the cross-slide until it reaches the center when the ball is finished, the noncutting half of the tool serving to support the work in one direction, from the thrust of the cutting half. This form of tool was new to me but seemed to make a quite satisfactory job.

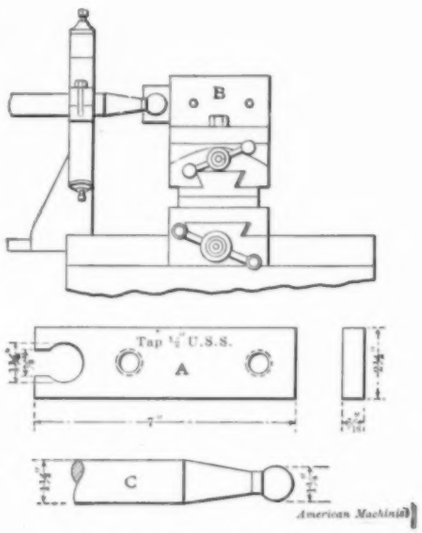


FIG. 2. THE BALL TOOL

GEORGE E. GAY.

Manchester, England.

A Reamer Grinding Kink

I had considerable difficulty in grinding some taper reamers, owing to the fact that no matter what grade or grain of wheel I used it would become glazed and, of course, burn the reamer. It was impossible to grind all of the teeth, of which there were eight, without turning off the wheel which meant a slow operation and also made it difficult to obtain accuracy. Water bettered the conditions little, if any, but I finally prevented the glazing in this way: I took an oil can containing machine oil and put some on both sides of the wheel as near to the spindle as possible. The wheel quickly absorbed the oil and when the wheel was in motion the centrifugal force caused the oil to pass through the wheel and

come off the face in a fine spray; the presence of the oil on the wheel prevented the latter from glazing and I ground the reamers with no further trouble. This could be applied with success to most any grinding job where difficulty is encountered owing to the wheel glazing.

FRANK D. O'BRIEN.

Rochester, N. Y.

A Fixture for Machining the Ends of Parsons Turbine Blades

The principal peculiarity about this fixture is that it uses a leather belt to clamp the work in the fixture.

Fig. 1 shows three of the blades. The stock is a special brass drawn to the shape shown at *H*, Fig. 2. It comes in rods about ten feet long and the first operation is cutting to length. This is done in an ordinary punch press. At each

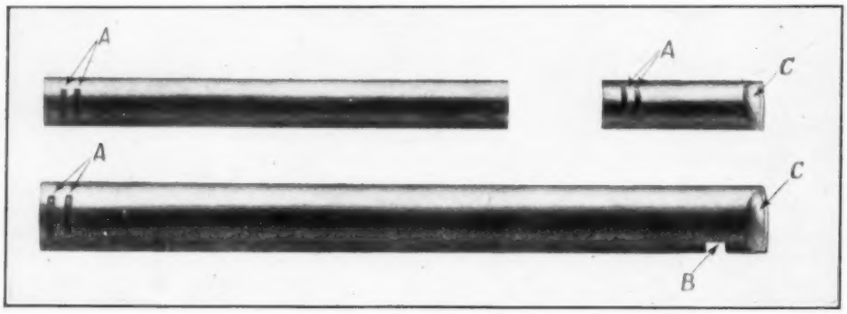


FIG. 1. THREE OF THE BLADES

stroke of the press the die drives in the two depressions at *A*, cuts out the notch at *B* and shears a blade to length. Some of the blades are without the notch at *B* in which case each stroke of the press performs the other two operations only. The groove *C* is at the outer end of the blade and is made on the fixture shown in Fig. 2. *A* is a shaft which has slots or splines *B* planed in it the width of the turbine blades. As there are several standard widths of blades, there are also corresponding shafts which fit the same bearings and are easily interchanged. The collar *C* at one end acts as a stop for the ends of the blades. *D* is the saw which cuts the groove in the end of the blade. *E* is a leather belt which clamps the blades in the splines *B*. The belt *E* is also used to drive the shaft *A*.

A boy operates the machine, placing the blanks in each spline in rotation as it reaches the position B^1, seeing that it is up against the stop *C* and holding it in place till the belt clamps it in place. The edges of the splines take the thrust while the saw is cutting. When the blade passes the saw and reaches the bottom position B^2 the belt releases it and it drops off if it is long. If it is short, a piece of bent cold-rolled flat steel *F*, placed at an angle, sweeps it off the belt as the belt, acting as a conveyer, carries it along. The blades are made right and left hand. When the left-hand blades are being grooved in the fixture, the belt and saw are reversed and the blanks are fed in, passing under the bottom and delivered finished at the top. The reason for this is that the drawn blanks are thinner on one edge than on the other and the difference between right- and left-hand blades is determined by whether the thin edge faces to the right or the left. In cutting the grooves if the thick edge of the blade is fed to the saw the saw is liable to lift it from the spline in the shaft *A*. It is, therefore, fed with thin edge first. The saw starting at the thin edge tends to hold the blade against the bottom of the spline in the shaft.

At *G* is shown a section of the shaft *A* with the blades *H* in position in the splines *B*.

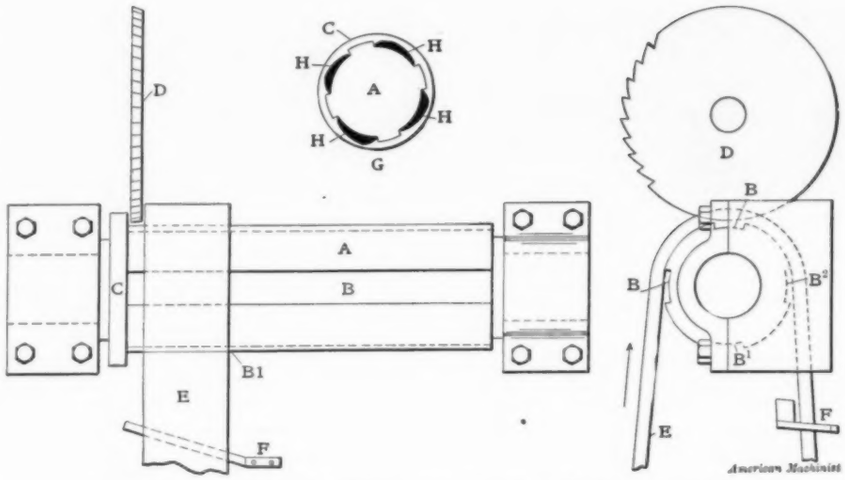


FIG. 2. FIXTURE FOR GROOVING THE ENDS OF TURBINE BLADES

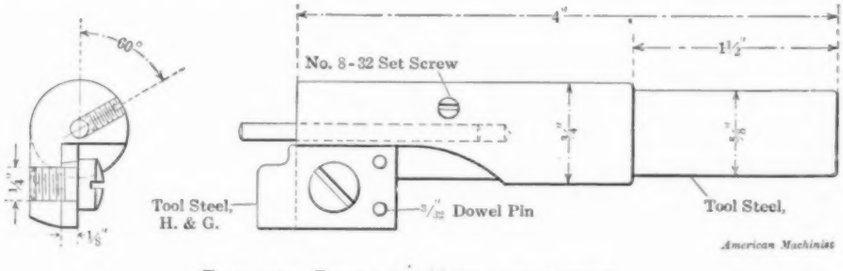
New York. J. WATT.

Hub or Boss Finishing Tool

There are times when a toolmaker has a piece of work which must be finished all over, often just for appearance. When this work happens to be studded with bosses, it often is very difficult to finish.

But if a tool like the one shown be made to suit the work, the finishing of the piece will be as simple as any ordinary work. The flat surface of the piece can be finished either by planing, turning or grinding, depending upon the shape, then the bosses finished with the tool shown. This tool is best adapted to small work that is to be used for model or exhibition purposes.

As the shape of the tool is such that it can be used in either a drill press, lathe or milling machine, it will be found very handy.



TOOL FOR FINISHING HUBS AND BOSSES

G. E. DAWSON.

Bridgeport, Conn.

A rather notable installation of huge machinery in the Orient includes a 150-ton hammer crane installed in a Japanese dock yard. The machine is of British manufacture, 177 feet high and is operated by five separate motors. It has a jib arm of 156½ feet with power transmitted by spur and bevel gearing.

? DISCUSSION of the PREVIOUS QUESTION ?

Letters from our Readers showing how many Men of many Minds look upon Various Subjects Opened up in previous Numbers

A Spring Winding Rig

I note at page 1146, Volume 32, Part 2, the exception taken to the results I obtained with the spring-winding rig illustrated at page 837. I have been identified with this problem for some time and am, therefore, entitled to a little hearing. During the development of this experimental machine, a large quantity of springs of various sizes were wound more or less imperfectly. I am certain your correspondent based his exception on a "casual inspection" of one of these springs.

I early discovered that in the use of this machine there is a certain best ratio between the outside diameter of spring and the size of wire, which should be maintained. The ratios between 6:1 and 8:1 have been used with success. One can conceive of a wire wound about a geometrical line as well as of the other extreme, but in practice the two limits are comparatively close together.

The "crushing" effect Mr. Carson speaks of is entirely negligible in the machine before described. The combined arbor and rollers have a grip on the wire in excess of that required, and that too without damaging it.

In action the arbor with the aid of the rollers draws the wire about itself in perfect coils which are continuously released as the spring is produced.

There is one possible improvement I might add and this only for springs whose ratio was much greater than 8:1. That is a device to retard the release of the coils until they were well past the leading edges of the rollers.

Why this spring-winding rig has not been built into a permanent form and put to work is not known to me. Perhaps it is because this is not a spring factory.

Dayton, O. M. F. BATES.

Examples in Modern Grinding Practice—The Pebble and the Wheel

I read with much interest Mr. Darbyshire's article at page 728, Volume 32, Part 2, on modern grinding practice, also Mr. Tappan's article at page 961, and I am pleased to give a little information concerning the pebble about which he inquires: I have used a flat piece of slate for the same purpose as Mr. Darbyshire uses the pebble but I prefer a Norton india oil stone. I have also seen a piece of an alundum wheel used which answers the same purpose. I hold the stone in my hand, as it is applied to the wheel lightly, otherwise the wheel will run out.

Birmingham, England. J. W. B.

Figures in the Drawing Room

Referring to the article, on page 127, regarding shape of figures, I believe more mistakes result in confusing the figure 9, made with the straight tail, with the figure 4, than is the case with the 9 and 6, when the 9 is made with the curved tail.

If the straight 9 is used, the 4 should be made with the top open, as in ordinary script figures.

Philadelphia, Penn. T. H. HARRIS.

Spining Brass Bowls

I have noticed at page 1149, Volume 32, Part 2, an article on a spinning operation, the article so spun being more or less in the nature of a ball with a curled open end, also a description of the chucks and method in which same is made, etc. I will say that the custom of spinning an article of this kind (or in fact anything of a similar nature) from the blank is more or less obsolete, and is only resorted to when there is only a small number required, or in other words, something odd or out of the standard lines.

Usually, to make a ball or a bowl such as described in this article, in shops that make a specialty of such things, a press operation is used to a great advantage in that a shell is drawn similar to Fig. 1, in which you will note the nose is a perfect half ball, and fits around the sectional spinning chuck in which the article is to be finished. Before spinning this shell will have to be annealed.

It isn't necessary to dilate upon the advantages of doing this whenever possible, as the metal, at the start, is drawn evenly and uniformly, and is not exposed to the irregularities of the hand tool used by the operator in "laying" over the stock, because if the blank is of any fair size at all, it is liable to become "wavy," Fig. 2, and the blank spoiled. To overcome this, the operator usually applies a *stick* opposite to the place where the pressure is applied by the hand tool, and in other words supports the blank by something more substantial than *air*. Usually a blank of any fair size spun this shape

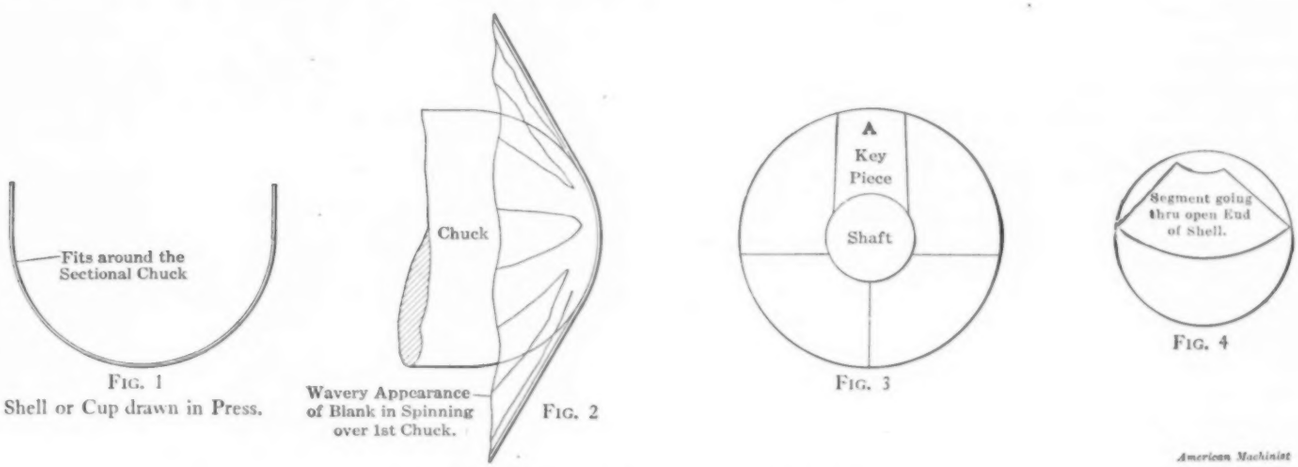


FIG. 1 Shell or Cup drawn in Press.

FIG. 2

FIG. 3

FIG. 4

DIFFERENT STAGES OF DRAWING UP A BRASS BOWL

has to be annealed and in some cases hammered with a mallet on a smooth hardwood block around the outer edge to overcome this "wavy" effect, and unless this is done, this "wavy" appearance in time becomes a "lap" or a "wrinkle" which it is utterly impossible to "iron" or "burnish" out with the hand tool.

The advantages of the most severe operation of all in having the "cup" drawn in the press instead of spun by hand are obvious, and if the "run" is fairly large and there is a press available, either single or double action (double action preferred) a die can be hurriedly made to make same, and in some cases a die is used that is slightly larger and a metal nose is added to the plunger to conform as nearly as possible to the shape of the finished article. Then a shell is drawn and spun over a chuck and brought down to the exact shape and size of the nose of the sectional chuck, then annealed before spinning on this last chuck.

Dogwood is used preferably to maple, but in case this cannot be had, maple is our next standby. It is more economical in case of a long run, to have one made of steel, as the continual pressure of the burnishing tool in the hands of the operator against this wooden chuck finally leaves its mark and the result is that ridges begin to appear on the spun surfaces which are merely copies of the ridges of the wooden chuck put there by the uneven pressure of the operator, and have to be "skimmed" off.

In the making of a sectional spinning chuck the sizes of the sections are usually determined by the *open end* of the article to be spun, and made of as few pieces as possible. For illustration, Fig. 6 of that article shows 12 such pieces which number does not make for rapid handling of this class of goods. The main part of the chuck is as represented in Fig. 4 (your article), that is, that part that contains the shaft *B* and the groove *C*. Then there should be one key piece *A*, Fig. 3 which you will notice is in the form of a wedge, the large part of which rests around or against the shaft *B*, and which insures an instantaneous collapse of the sectional chuck when pulled off of the shaft *B*, in that this key section *A* falls in the opening formerly occupied by the shaft *B* and is easily withdrawn through the shell so spun, and in turn provides easy removal of the other sections, which, considering the size of the opening of spun article, such as shown, should not consist of more than five pieces all told, as per Fig. 3. You will notice that all these pieces across their backs, as in Fig. 4, are smaller than the opening in bowl spun, and this shows how readily same can be removed after the key piece has been taken out. For convenience these pieces are numbered. The shell is spun and finished more or less, as described in previous article.

A. C. RANTSCH,
Master Mechanic, Republic Metalware Company.
Buffalo, N. Y.

Is the Prony Brake Unreliable?

James W. Hughes' statement on page 953, Volume 32, Part 2, that ordinary dynamometers of the Prony brake class have "a serious fault of such a magnitude as to make them utterly unreliable if not worthless," is important, if true. The following calculations will show that Mr. Hughes has failed to prove his case, and that his paradox still remains to be explained.

It is a good plan when a lot of algebraic calculations apparently lead to a result that is not credible, to try a special arithmetical case. I have done this in what follows, taking the length of the shaft, the length of the arms and the diagonal *M B*, respectively, 4, 3 and 5 feet, so as to have a right-angled triangle which will involve no complicated

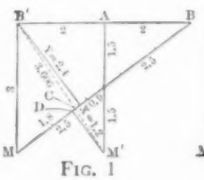


FIG. 1

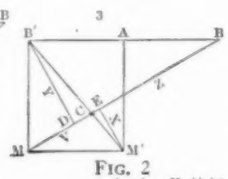


FIG. 2

American Machinist

trigonometry in its solution. The dimensions are marked on the several lines of the sketch, Fig. 1.

100 pounds at *M* with lever arm 1.2 produces reaction at

$$B = 100 \times \frac{1.2}{2.4} = 50.$$

Downward vertical force at $C = 100 + 50 = 150$.

$$B\,M = A\,M' = 3.\quad B'\,A = 2.$$

$$B'\,M' = \sqrt{3^2 + 2^2} = \sqrt{13} = 3.6056.$$

$$C\,M' = 1\tfrac{1}{2}.\quad B'\,M' = 1.20187,$$

$$C\,D = \sqrt{C\,M' - M\,D} = 0.067.$$

$$Z = B\,C = 2.5 + 0.9 - 0.067 = 3.333,$$

$$V = M\,C = 5 - 3.333 = 1.667,$$

or as 2 to 1.

The 150 pounds pressing downward at *C* is, therefore, carried at *M* and *B* in inverse proportion to the lever arms *M C* or *B C*, that is, 100 pounds at *M* and 50 pounds at *B*.

Mr. Hughes says: "Hence, a weight of 100 pounds on the fulcrum *M'* will produce a load on the scales *T* equal to

$$\frac{Z}{V+Z}\left(100 + \frac{100\,X}{Y}\right)$$

instead of 100 pounds, as is generally believed." But $Z = 3.333$, $V + Z = 5$, and $\frac{X}{Y} = 1\frac{1}{2}$, therefore, the load on the scales is $\frac{3.333}{5} \times (100 + 50)$, or $\frac{2}{3}$ of 150, or 100 pounds "as generally believed."

This is for the special arithmetical case, but it may be proved for the general case, by geometry, when the length of the arms is equal. See Fig. 2.

Let

$$B'\,D = Y,\ E\,M' = X,\ M\,E = V,\ E\,B = Z.$$

Then by similar triangles,

$$V + CE : X :: Z + CD : Y.$$

But *C D* and *C E* are, respectively, proportional to *Y* and *X*.

Let

$$C\,D = aY \text{ and } C\,E = aX.$$

Then

$$V + aX : X :: Z + aY : Y$$

$$V\,Y + aX\,Y = Z\,X + aX\,Y,$$

whence

$$V\,Y = Z\,X,\ \frac{X}{Y} = \frac{V}{Z}.$$

Mr. Hughes' formula for the load on the scales is

$$T = \frac{Z}{V+Z}\left(W + W\,\frac{X}{Y}\right).$$

Substituting for $\frac{X}{Y}$ its value $\frac{V}{Z}$ we have

$$T = \frac{Z}{V+Z}\left(\frac{W\,(Z+V)}{Z}\right),$$

whence

$$T = W.$$

That is, when the arms are equal, the load on the scales is equal to the weight applied.

Still another way of proving it: Let *B B'* be a rigid horizontal shaft, pivoted at *B* and *B'*, and let *B' M* and *A M'* be two horizontal arms of equal length, rigidly attached to the shaft. Let a load of 100 pounds be applied vertically at *M'*, pushing it downward, say, one inch. Since the arms are rigidly attached so that one cannot move downward more than the other, the push downward by *M*, or its resistance to being pushed downward, cannot be more than 100 pounds, or 100 inch-pounds of energy exerted at *M'* cannot develop more than 100 inch-pounds at *M*.

Mr. Hughes' new dynamometer seems to be a good one for the purpose for which it is used, although he says it is rather expensive. It is somewhat similar to the transmission dynamometer made by Franklin Van Winkle, of Paterson, N. J., in which helical springs were used instead of a coiled spring. Mr. Van Winkle made quite a number of these machines in the days before it became customary to measure the transmission of power by electrical methods. I designed a transmission dynamometer myself more than 30 years ago, and one was built in the Stevens Institute of Technology about 1879, and I believe is still used there by the students. A description of it was published shortly afterward in the *Transactions* of the American Institute of Mining Engineers.

Montclair, N. J. WM. KENT.

Machining Automobile Cylinders

I was much interested in the article on page 857, Part 2, Volume 32, of the AMERICAN MACHINIST on the above subject, by James McIntosh. It is generally conceded that the accurate finishing of an automobile cylinder is a skilled job that calls for highly skilled operators.

As regards annealing the castings, I am of the same opinion as Mr. McIntosh and don't think that annealing these intricately cored castings is beneficial, nor commercially practicable. As regards boring heads an even number of cutting edges no doubt facilitates calipering, but when the cutters are adjustable that is not an important item. Fig. 1 shows a form of cutter head I have seen used to good advantage for boring automobile cylinders, of the single and double casting type, on turret lathes. Only 3 cutting edges are contained in each boring head, as shown at *A*, *B* and *C*; *D*, *E* and *F* being the square-headed set screws for securing the cutters in position and *G* a slot milled across the back of the steel boring head for driving purposes. We run two of these boring heads into each cylinder; the bar being steadied as near the cylinder as possible.

They are finished ready for grinding with type of bit shown in Fig. 2, that has a single flat steel adjustable cutter *H* secured by two set screws *I* and *J*, that fit into elongated slots in the cutter to allow for adjustment. At *K* and *L* are two hardened-steel guide strips that are dovetailed into the steel bit but to keep it rigid and free from chatter when boring. At *M* and *N* are two 3/8-inch grub screws for adjusting the cutter *H*, which should not have above 1/32 inch to skim out of the cylinder.

After 4 years' experience we have found this type of finishing cutter to give entire satisfaction and have compieted some hundreds of cylinders with them. We have tried boring the cylinders with a water bath playing on, and could attain a very high cutting speed, but this method made the castings warp more than when bored dry; so we reverted to the latter process.

After our cylinders are bored, leaving about 0.012 inch for grinding, they are left a few days to allow the pent up strains to exert themselves, and then they are ground out to size. Although it is a most difficult job to grind them dead true, yet we can get them within very fine limits, say 0.0005 inch at the outside.

We spent a long time experimenting on the grinding before we attained the best results, and it may surprise some to learn that we always grind them wet. We keep a clean water bath playing on them. No suds or greasy substance is allowed in the bath as that would prevent the wheel from cutting freely, and give it more of a rubbing or glazing action. By these methods our cylinders have been admired.

Some people say that grinding, that is, when the wheel is a free cutting one and does not rule, opens the pores of the iron and lets the gases escape past the piston rings, but I cannot see that, and in my opinion grinding is cheaper and far superior to any other method of finishing these cylinders. Finishing by reaming is slow, and reamers are difficult to keep to size.

I have seen a dummy piston fitted into a drilling machine and emery powder and oil thrown on it to finish the cylinder but that method is even slower still, and besides, particles of emery can easily get into the pores of the cylinder walls, and thereby do considerable damage to the piston and rings when the engine is fitted up. Personally I do not consider

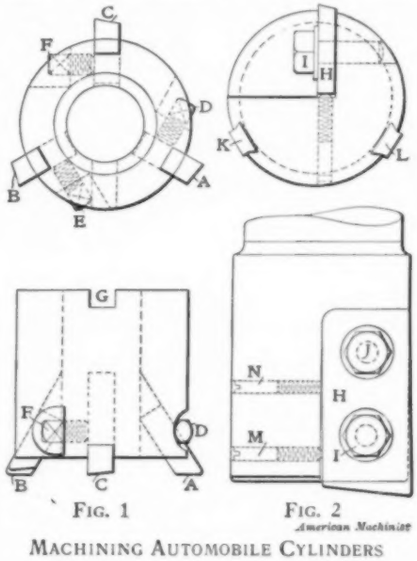


FIG. 1 FIG. 2

American Machinist

MACHINING AUTOMOBILE CYLINDERS

this lapping method is so good as grinding.

When grinding the pistons we finish them slightly taper to allow for the unequal expansion of metal under working conditions. The top, or crown of the piston, which comes in contact with the exploding gases, and contains more metal, gets considerably hotter than the lower part and consequently expand more. Therefore we grind the top part about 0.005 inch less in diameter than the part below the rings, gradually tapering it down. Thus for a cylinder ground to 4.5 inches we grind the piston to 4.492 inches diameter above the top ring, and 4.497 inches at the bottom; which is 0.003 inch less than the cylinder when both are cold. But as the piston will expand slightly more than the cylinder, the latter being water cooled, there will not be 0.003 inch clearance when the engine is working and probably not above 0.001 inch, which is a very fine working limit. As both cylinder and piston are highly finished, and good provisions are made for lubrication, with these limits we have never yet had a piston seize, which speaks well for the workmanship.

NORMAN W. POWELL.

Coventry, Eng.

Correcting an Error in a Crank Shaft

Referring to H. T. Clark's article "Correcting an Error in a Crankshaft," on page 999, Volume 32, Part 2, I beg to state it is rather too much to ask the mechanical world to accept such an achievement.

He mentions a large crank shaft being shortened 1 inch between the crank sweeps by heating the part marked *A* (see figure page 999), then placing the shaft between lathe centers, screwing up the tailstock till the crank pins become the correct distance apart and then turning the swelled portion down to the original diameter.

Such an operation would be sufficient to strip the thread of the screwed nut in the spindle, and at the same time force the screws which hold the screw thrust block, out of their position.

Assuming that lead when cold and steel when at a bright red heat, require the same pressure to compress, let us imagine the shaft to be at least 6 inches diameter at part *A*. This is an area of 28.27 square inches.

Molesworth in his book of engineering formulas gives the crushing weight for lead at 3.1 tons per square inch. Working with these figures, that means the shaft would require a force of

$$3.1 \times 28.27 = 87.63$$

tons to compress it.

Obviously it would necessitate a very large handwheel and some strong man at the rim to create such a force, even if the parts of the tailstock would stand the stress.

The above is worked out on an assumption but before leaving this article, I might say that to twist a crank shaft is far easier than to compress it so that it will alter its form; and to twist the neck of a crank shaft, 4 inches diameter, so that the crank pins would have certain positions relative to each other, a force of 26 foot tons was found to be necessary, by actual experiment.

Manchester, England. A. H. PIERCE.

From official records issued by the Commissioner of Patents, it is noted that during the year 1909, 64,408 applications for patents were received and 1234 applications for designs. Of these, 37,261 letters patent were issued. The statistics include a statement showing the number of patents issued by the United States and foreign countries from the earliest period to December, 1909, to have been 2,999,733. New York headed the list of States with 5232 patents.

PRESCRIBED COMPENSATION vs. EMPLOYERS' LIABILITY

Facts Showing Advantages to All Concerned

BY H. H. FRANKLIN *

The average employer feels that he must carry employer's liability insurance. The risk of accidents, together with the risk of litigation promoted by shyster lawyers, is more than the ordinary employer's business can stand. To be secure in his business he must carry liability insurance.

The ordinary employer's liability-insurance policy has a clause which reads: "The assured shall not voluntarily assume any liability or interfere in any negotiations for settlement or in any legal proceedings . . . . without the written consent of the insurance company previously given."

This clause practically places the settlement of all claims for injuries in the hands of the insurance company. The result of the situation is that ordinarily the employer reports at once to the insurance company the accident and then leaves the matter wholly to the company to do as it sees fit. If the employer should give money to the injured employee or his family, or should provide him with a nurse or a doctor, or should even visit the employee to inquire about his condition, it might be taken as an indication that the employer considered himself liable for the injury and thus embarrass the insurance company in its efforts to settle or litigate the injured employee's claim. If the insurance company in any case should give its consent to the employer to pay money or give aid to the injured employee, it would be on condition that the employee should sign a release of his claim and thus put the employer in the position of driving a hard bargain with the injured employee rather than in the position of doing for the employee what was just or right or humane.

The results of the above system of handling accident claims tends to produce distrust and strained relations between employer and employee. It lets the whole matter down upon the harsh basis of legal liability and turns over to a third party (the insurance company which has no direct interest in the injured employee or in his harmonious relations with his employer), the whole work of settling or otherwise disposing of claims, in such a manner as to save the most for the insurance company, largely independent of what the employee should receive for his injury and of the harmonious relations between the employee and his employer.

The Present System Is Wasteful

It is our observation that only about one-third of the money paid by employers to liability-insurance companies for protection against liability for accident to employees, goes to the injured employees themselves, and that of the money recovered by the injured employees by means of litigation only about one-half goes to the employees themselves, the remainder being kept by the attorneys.

During the two years ending October 1, 1909, the H. H. Franklin Manufacturing Company expended for liability insurance the sum of $3517.05. During this time the insurance company paid to and for injured employees, including first surgical aid, amounts paid in settlement of claims and as a result of litigation, the sum of $1926.03. Of this amount $868.12 was paid as the result of litigation. Assuming that one-half of that $868.12 went to the attorneys for the injured persons, then the total received by the injured employees was $1491.97.

During the two years the average number of employees of the company was 1244.

The total wages paid during the two years was $1,737,910.07.

During the two years 119 accidents to employees occurred which were taken care of by the insurance companies.

By reason of the large contingent fees allowed to attorneys in accident cases and by reason of the uncertainties of jury trials, there are attorneys in all the large cities who promote litigation against employers on claims which have no merit. Practically every employer considers these attorneys a menace to his business. They cause the employer much expense and make him distrustful of every claim that is made against him through an attorney. Consequently he is obliged to employ attorneys in many cases where none should be required. All the money expended in this way is lost to everyone except the attorneys.

The experience of the Franklin company during the two years given above possibly is not what it would be for a longer period. Also it is fair to assume that the experience of the Franklin company may not be the experience of all other companies. The Franklin company, however, can be considered fairly typical of a large class of industries which employ skilled workmen, such as machinists, blacksmiths, tinsmiths, toolmakers, woodworkers, upholsterers, painters, etc., as all these classes of workmen are employed in its factory.

Prevention of Accidents

The employer is reasonably well interested in preventing accidents which arise from his own fault, because for these, under the present system, he is held responsible; but inasmuch as he usually carries liability insurance, his interest as regards these accidents shows itself mainly in an effort to meet two requirements: First, those of the insurance companies and second, of the State laws. When the employer has met these requirements he considers that he is within the line of safety.

As regards accidents which do not result from his own fault or negligence, the employer is likely to take very little interest, as these generally do not cost him anything. Inasmuch as probably 95 per cent. of the accidents occur without any legal fault or negligence on the part of the employer, it will be seen that in preventing the great majority of accidents the present system is not likely to make the employer interested.

Of the 119 accidents occurring to the employees of the H. H. Franklin Manufacturing Company during the two years ending October 1, 1909, only five could be said to have resulted in any way from the legal fault or negligence of the company.

The present system makes the employer continually ask "Am I legally liable?" not "Is the injured employee receiving the best possible care?" Under the present system the matter of the injured employee's care and his quick recovery is of no importance in dollars and cents in that large class of cases where the employee is at fault.

If there were a system which made it of importance, unquestionably injured employees would receive better care and the interests of both employer and employee would be promoted.

No Relief to Injured Employees

Under the present system where the injury results from the legal fault of the employee, he gets no compensation, and if the accident is so serious as to destroy in whole or in part his earning power he, and those dependent upon him, are likely to become objects of charity or burdens upon the State.

*President of H. H. Franklin Manufacturing Company, Syracuse, N. Y. Presented to New York State Commission on Employers' Liability, etc.

Under the present system the injury to the employee is increased from the fact that whenever he brings a suit to recover compensation for his injury, he is likely discharged by his employer. If not discharged, the bringing of the suit makes a strained relation between the injured employee and the employer, which is practically as bad as if he were discharged. In view of this situation, it often happens that while the suit is pending, the injured employee is out of work and if he fails to recover in his suit, he not only has no compensation for his injury, but has lost the position by which he earned a livelihood for himself and those dependent upon him.

The workingman's job is his capital. The answer to the question as to who is to blame for an injury which affects this job does not necessarily determine what the injured person in justice should receive. Instead of the State asking of the injured man: "By whose fault were you hurt?" it might more properly say "Your injury came as an accident to the business in which you were employed and that business should compensate you for the injury received just as much as it must compensate you for the physical energy which you have put into your employer's service."

Removing Existing Conditions

The H. H. Franklin Manufacturing Company believes that the existing objectionable conditions relating to compensation to injured employees for industrial accidents might be largely removed by the enactment of a statute similar to the English Workmen's Compensation Act of 1906, which would give to all employees injured in the performance of their work a definite compensation, with provisions for a sure and quick recovery of this compensation at small expense.

Such a statute should contain in our opinion the following general provisions:

(1) Compensation to all employees for injuries received in commercial or industrial employment independent of the question as to whether or not the injuries were a result of the employer's fault or negligence. The only exception should be that the disability should be for more than one week and not caused by the wilful misconduct of the employee.

Disability for less than one week should be disregarded because thereby the possibility of pretended injuries will be largely prevented.

Compensation should continue during the period of disability at the rate of at least 50 per cent. of the wages received by the employee at the time of the injury. The compensation should be materially less than full wages in order to check the feigning of disability after it has ceased to exist.

For specific injuries, such as the loss of a hand, a foot, an eye, etc., specific compensation should be paid, based upon the wages which the employee was receiving at the time of the injury; e.g., for loss of one hand 50 per cent. of weekly wages for one year or other specified time; for loss of both hands the whole of the weekly wages for a specified time.

In the case of injury resulting in death, if the deceased left persons wholly dependent upon him, then such dependents should receive a sum equal to at least three years' wages of what the deceased was receiving at the time of the injury.

If the deceased left persons only partly dependent upon him, then the amount to be paid by the employer should be materially less.

If the deceased left no persons wholly or partly dependent upon him, then the employer should be only required to pay for medicial and surgical treatment of the injured employee, together with funeral expenses.

Compensation should be paid in instalments and should be nonassignable in order to prevent dissipation by the beneficiaries.

No person should be considered an employee, as the term is used in proposed act, who receives over $1200 per year.

For the purpose of testing the proposed law, it would probably be wise to exclude from its provisions farm employees and domestic servants.

The compensation provided to be paid by the statute should be in lieu of all other compensation recoverable by action at law or by other means, except that where the injury resulted from failure of the employer to observe some specific requirement of the statute law of the State in regard to furnishing safety appliances, safeguards against accidents, etc., the injured employee should have the option of taking the compensation provided by this proposed statute or the compensation which he might recover in an action at law.

(2) If the employee's injury should occur while in the performance of his employer's work, but from the negligence or fault of some person other than the employer, the employer should be liable for the compensation provided to be paid by the proposed statute; but the employer might recover the amount of the compensation paid by him from the person by whose negligence or fault the injury was produced. Also the injured employee may have his choice of the benefits of the proposed statute or of action at law against the third person causing the injury.

(3) The proposed statute should make provision by which substantially all the money paid by the employer shall go direct to the injured employee.

The promotion of litigation by attorneys or other persons who live by the collection of accident claims from employers, and who are a menace and an expense to both the employer and employee, should be prevented.

One method of accomplishing this would be to devise a plan for the settlement by arbitration of practically all of the questions arising under the statute. The arbitrators might be a committee agreed upon by the employer and by a majority vote of the employees, or it might be some person agreed upon by the employer and the employee who has been injured, or it might be an arbitrator to be named by the county judge, or it might be the county judge himself. The arbitrators or arbitrator should have the right to call to their assistance any medical referee who has been appointed to give aid in such matters. A suitable number of medical referees should be appointed for each county of the State. They should be paid by the State or county, and should be required to render services in cases of dispute under the proposed statute, without cost.

The procedure, costs, etc., of arbitration might be prescribed by the county judge. It should be within the discretion of the arbitrators or arbitrator to determine which party to the arbitration should pay the expenses; but in no case should such expenses, including attorney's fees, exceed those specified in the rules of procedure.

(4) If an employer should go into bankruptcy, compensation owing to employees under this law should be a preferred claim.

(5) The proposed statute should be supplemented by a statute making specific requirements of all employers in commercial and industrial lines of business to use safety appliances, and safeguards for the prevention of injuries to employees.

Constitutionality of Proposed Law

If the proposed law would violate the State Constitution because it would limit the amount to be recovered for injuries resulting in death as provided in Section 6, Article 1, of the Constitution, or because it would take away the right of trial by jury, as allowed by Section 2, Article 1, of the Constitution, then either the State Constitution should be amended so as to make the proposed law constitutional, or means should be provided by which both the employee and employer may waive their constitutional rights. Some plan of mutual agreement between the employer and employees might be devised. This agreement should be subject to approval of the State Department of Labor or some other State department, and this department should have supervision of the working of the agreement.

We do not claim to have gone into the matter of constitutionality of the proposed law thoroughly, but it seems to us

that possibly the constitutional questions could be avoided by an optional plan similar to that provided by the English Compensation Act of 1906, by which the employer is allowed to organize a benefit or insurance scheme to take the place of the compensation act, or by such an optional plan as is provided by the Massachusetts Act of 1908. Possibly the optional plan might be provided for, pending the necessary amendments to the State Constitution.

Unity of Interest

Both the employer and employee would be interested in preventing accidents, whether such accidents came from the fault of the employer or the employee. The employee would be interested because he would not desire to have the injury, suffering, and loss of wages which the accident would cause. The employer would be interested because he would desire to avoid as much as possible the payment of the compensation which the accidents would require.

Also both the employer and employee would be interested in having the injured employee well cared for and in condition to quickly return to work. The injured employee would be interested because his care and recovery would lessen his sufferings and loss of wages, while such care and recovery would relieve the employer from continuing the benefit payments.

The importance of disputes which exist under the present system between the employer and the injured employee, viz., the question of liability for the injury, and the question of the amount to be paid, would be practically settled by the statute, leaving only minor, unimportant questions which in most cases would be settled by friendly agreement between the employer and employee.

Would Prevent Waste of Money

Under the proposed statute more money would go to the injured employees than under the present system; while, in our opinion, the employers would be required to pay less than they now pay for liability insurance and other expenses necessary under the present system.

Under the experience of our company for two years ending October 1, 1909, during which time 119 accidents occurred, if the proposed system had been in force and we paid one-half wages to all injured employees for all the time lost on account of such injuries, and wages for three years in the case of one employee who died, we would have paid during the two years, $2091.83, all of which unquestionably would have gone to the injured employees and those dependent upon them.

During the two years aforesaid we did pay $3517.05 for liability insurance. During this time the injured employees received of the insurance companies $1491.97, of which $278 was for surgical aid or medical attendance, $779.91 for settlement of claims, and $434.06 as a result of actions at law. In the actions at law it is assumed that the attorneys for the injured employees received the same as the employees themselves.

With the important questions now litigated in accident cases settled by the provisions of the proposed statute and with a method of arbitration for the settlement of other questions, it is our opinion that in only a few cases would the injured employees require the services of a lawyer, and thus this expense or waste would be practically eliminated.

Incentive for Preventing Accidents

The interest in preventing accidents would be common to all employers of the State and in all probability this interest would result in the formation of mutual employers' liability insurance companies, which would unite the employers for the purpose of making the cost of insurance as light as possible. Unquestionably the plan of mutual insurance would offer inducements to all members of the company to make as great improvements as possible in safety appliances, accident safeguards, etc., in order to keep the premium rates for insurance as low as possible. For like reason the plan would offer inducements to make improvements in the care of injured employees so as to insure their quick recovery and thus lessen the amount of compensation paid.

Less Expensive than Present Pian

If the proposed law had been in force during the two years ending October 1, 1909, as appears by the figures previously given, the H. H. Franklin Manufacturing Company would have saved approximately $1425.22, or approximately 40 per cent. of the amount paid, while the injured employees would have gained approximately $599.86, or approximately 40 per cent. more than the amount received.

It leaves the administration of the proposed statute in the hands of the employer and employee.

The plan does not take away the independence of either the employer or employee, and will not make the employee feel that he is an object of charity either on the part of the employer or of the State.

General Remarks and Summary

The present plan is primitive, adapted to industrial conditions much more simple than those at present. It is inadequate to meet labor conditions in this time of immense factories, varied and complicated machinery, large number of employees, etc.

The present plan breeds inhumanity. Where the injury results from the employee's own fault, it leaves him and those dependent upon him to take care of themselves. Where the injury is the fault of the employer, it induces the employer to drive as hard a bargain as possible with the injured employee.

The benefits of the proposed system may be summarized as follows:

Promotion of harmonious relations between employers and employees.

No waste of money.

Compensation will be immediate and direct.

Number of accidents will be reduced by improved appliances, etc.

Better treatment and care will be given to injured employees.

Mutual liability-insurance societies will result and cost to employers will be less than under the present system.

Injured employees and those dependent upon them will be kept from becoming objects of charity or charges upon the State.

Heat Treatment of Steel

By E. M. Bain

I would like someone who *knows* about treating steels to tell me if the following is just a chance or can be done every time. It was told me by a man who vouched for it as a personal experience. A certain circular forming tool was to have been made of high-speed steel, but when he went to the steel merchant the only steel of the size available was a piece of good carbon stock. This was bought and turned over to the toolmaker, but through an oversight the toolmaker was not told that it was carbon steel.

Supposing it to be high-speed stock he hardened it after the approved method for the brand of high-speed steel which he *thought* it was. The man who used it in the machine was so pleased that he praised it to the man who had bought the stock. Upon inquiry the purchaser of the stock found that the toolmaker had treated it the same as he always treated high-speed steel, and in order to make sure that he had not fooled himself, the purchaser asked the people in the store if they had sold him carbon or high-speed steel, to which they replied "carbon steel."

The funny thing about it is that the toolmaker would not believe that it was carbon steel and the machine hand said it gave better results than any high-speed tool he had ever used.

I once treated a piece of common—very common—air-hardening steel according to high-speed methods and got similar results. These things tend to make us mechanics wonder if we are paying that extra 30 or 40 cents a pound for being told how to temper and also for being allowed to think we are getting something different and better for our money. I begin to suspect that maybe the steel men are laughing at us.

Bronze Memorial to Robert Henry Thurston

On Tuesday evening, February 8, the New York monthly meeting of the American Society of Mechanical Engineers was devoted to the dedication of a bronze memorial tablet to Dr. Robert H. Thurston. The beautiful memorial, which was made possible through the generosity of members and their devotion to Doctor Thurston, was the work of Herman H. McNeil, a former student and personal friend of Doctor Thurston. It is a replica of the memorial tablet presented to Sibley College, Cornell University, by alumni and students. The program of the evening, reviewing the life work of Doctor Thurston, was divided under several heads, which were assigned to former friends and associates of the man.

Dr. Alex C. Humphreys, president of Stevens Institute of Technology and chairman for the evening, opened the exercises with a short address and was followed by John E. Sweet, who had been closely associated with Doctor Thurston in the organization of the society.

Connection with the Society

Prof. John E. Sweet told the simple story of Doctor Thurston's connection with the society. His address, in part, follows:

To begin at the beginning—we must hark back to the fall of 1879 when the *American Machinist* was published in a small office at 96 Fulton street, New York City. The journal had been in existence but a few years, and had received contributions from a goodly number of contributors engaged in various branches of mechanical industries and from a wide section of the country. But very few of these contributors were known to the publishers, and fewer still to one another, and the notion came to my mind that it might not be a half bad idea to get as many of these contributors together as we well could, and give the publishers a surprise party, with a faint notion in my own mind that it might lead to an organization. I conveyed the notion of the surprise party to one of the contributors, and he at once gave it away to the editor, with the suggestion that some sort of a mechanical association be formed. The suggestion took root in the minds of the publishers, and Mr. Bailey, the editor, came up to Syracuse to see me about it, or, in fact, he came to inveigle me into writing the invitations; but, not being able to do that willingly, he made me do it any how. Among those invited were Alexander L. Holley and Prof. Robert H. Thurston, then in a sanitarium in Dansville, N. Y., both of whom entered heartily into the scheme, and invited many I did not know. Before the meeting, which was held on February 16, I came to New York, and Mr. Bailey and I had an interview with Mr. Holley, and each was to draw up some form of a program for the meeting, and meet the next day to compare notes.

Mr. Copeland, Charles T. Porter, Mr. Holley, E. D. Leavitt, Jr., and myself were chosen as a nominating committee. When the committee met it was found that the unanimous choice was for George H. Corliss for president. Mr. Corliss refusing, we tried William Sellers, who also declined for a much better reason, and, as Professor Thurston said later—"You couldn't get anyone to accept the presidency, so you hit upon me, a sick man, who could not help himself."

At what is now known as the first annual meeting held in New York City, November 4 and 5, Professor Thurston had regained his health, and was able to preside and deliver an able address.

Professor Thurston was elected president for the second time, and these two

Bronze Tablet Dedicated to Dr. Robert H. Thurston

years were the critical ones in the society's history. Not only while president, but for a long time later, Doctor Thurston was more instrumental in helping up the society than any other man.

As a Naval Engineer

Following Professor Sweet's address, a communication from Benjamin F. Isherwood, United States engineer-in-chief of the navy, retired with rank of rear admiral, was read by Professor Hutton and was, in part, as follows: "My long and intimate personal acquaintance with Professor Thurston was intensified by our professional interest in the same subjects. His exceptionally valuable life was devoted to the improvement of the world in the only way in which it could, in his opinion be improved, namely, by the cultivation of physical science. Those who knew him best, valued him the highest and his death saddened all who knew him well enough to appreciate his gentle qualities as well as his lofty aspirations."

The next speaker on the program, Rear Admiral George W. Melville, retired, past-president of the American Society of Mechanical Engineers, was unable to attend. His address, outlining Doctor Thurston's work in the navy during the Civil war and his services at the naval academy at Annapolis, was read by Doctor Humphreys.

At Stevens Institute

Col. E. A. Stevens, representative of the Stevens family, founders of Stevens Institute, spoke, in part, as follows: "The history of mechanical engineering in the United States will always bear witness to Doctor Thurston's ability, untiring energy and the liberality with which he freely gave to his beloved profession all that his ripe experience and trained observation could give. Whatever may have been the value of his other work at Stevens, none of it equals in importance his share in the development of the system of instruction and the influence of his personality and his standard of professional ethics on those who were thrown in contact with him.

In Literature and in Research

In speaking on this topic William Kent said that his acquaintance with Doctor Thurston began near the end of the year 1874, when he called upon him to make arrangements for entering the junior class in Stevens Institute of Technology. Doctor Thurston was then 35 years of age and was professor of mechanical engineering, meeting his classes two hours a day. At the same time he was editing the four volumes of reports of the United States Commission to the Vienna exhibition of 1873, one of the volumes being written by himself; he had shortly before that written a report of the United States Commission for investigating the causes of steam-boiler explosions; he was now planning the researches to be made by the United States Board to Test Iron, Steel and Other Metals, of which he was secretary and the most active member. Besides all this he was writing papers for the American Society of Civil Engineers and for the *Journal* of the Franklin Institute, concerning the results of his researches.

In 1871 he had conducted a series of boiler tests on several different makes of water-tube boilers at the American Institute fair in New York. In 1873 he had organized a mechanical-engineering laboratory for the purpose of making engineering researches, the first of the kind to be established in the United States. About the same time he invented his well-known autographic testing machine for testing materials by torsion, and later he invented the machine for testing lubricants, in which some of the principles of the torsion machine were embodied.

In 1873 Doctor Thurston discovered the phenomenon of the elevation of the elastic limit of iron and steel. It was also discovered independently in the same year by Commander L. A. Beardslee, U. S. N. In years following he tried to find other metals or alloys that exhibited the same peculiar action after being strained beyond their elastic limit, but never found one. In 1874 he investigated the burning of tanbark for fuel in specially constructed boiler furnaces, and in 1875 and 1876 he made a number of tests of steam boilers. For some years after 1876 he carried on investigations of lubricants, the results of which are in his book on "Friction and Lost Work." In later years his researches were not numerous or important, for the reason that his time was fully occupied with other work.

Doctor Thurston's literary work was not confined to engineering matters. In 1873 he contributed to the *Scientific American* a series of seventeen articles on his observations in Europe, which included not only what he had seen at the Vienna exhibition, and in the several iron works that he visited, but also his reflections on social conditions in the manufacturing centers.

Doctor Thurston's first important book after his report of the Vienna exhibition was his "History of the Growth of the Steam Engine," published by Appleton in 1878. It is written in his best style, and to those who are at all interested in the subject it is as readable as a novel. It illustrates his painstaking care to be sure of his facts, his skill in arranging them in logical order, and his good judgment in drawing conclusions. In 1877 he brought out a little book on "Steam Boiler Explosions in Theory and Practice."

Other books followed rapidly as shown by the list of books whose first editions appeared in the years 1882 to 1894, inclusive: "The Materials of Engineering," three volumes: 1, "Non-metallic Materials"; 2, "Iron and Steel"; 3, "Brasses, Bronzes and other Alloys"; "Text Book of Materials of Construction," "Treatise on Friction and Lost Work in Machinery and Millwork," "Manual of Steam Boilers, their Design, Construction and Operation," "Handbook of Engine and Boiler Trials, the Indicator and the Prony Brake," translation of Sadi Carnot's "Reflections on the Motive Power of Heat and on Machines Fitted to Develop that Power," "Life of Robert Fulton," "Manual of the Steam Engine," two volumes: 1, "History, Structure and Theory"; 2, "Design, Construction and Operation"; "Stationary Steam Engines Simple and Compound," "The Animal as a Machine and Prime Motor," and the "Laws of Energetics."

At Sibley College

Walter C. Kerr, director of Cornell University and president of Westinghouse, Church, Kerr & Co., recognized the impossibility of reviewing the full import of the eighteen years that Doctor Thurston devoted to Cornell University and limited his address to a few brief remarks on Doctor Thurston as an educator and organizer of rare talent, and also told how he was loved and respected at Cornell.

Medal Awarded to Edward G. Acheson

The latest recipient of the honor conferred by the Perkin medal is Edward Goodrich Acheson, president of the International Graphite Company, of Niagara Falls, N. Y. Doctor Acheson was born in 1856 and began active work in his father's blast furnace near Kittanning, making his first invention of a miners' drill, a year later.

Since that time he has worked pretty steadily along electrical lines, with Edison, in the making of lamps and in cable laying.

His discovery of carborundum dates back to 1891, when he fused coke, salt and sand into a substance that is next to the diamond in hardness.

Next came his floating of graphite in water and in oil, so thoroughly that it does not settle, and especially useful in lubricating machinery of various kinds. Among his 40 other inventions is synthetic or artificial rubber.

The receiving of medals is no new experience to Dr. Acheson as he has quite a collection which includes a grand prize at the Paris Exposition, another at St. Louis, Rumford medals, John Scott medals and now the Perkin medal.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

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American Machinist

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY

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Machine Tools in Unskilled Hands

The enormous development and activity of certain machine-building industries, notably automobile manufacturing, have brought about in some shops a combination of first-class machine tools and unskilled operators. In this combination the machine tools are liable to be the sufferers.

The growth of some plants has been so rapid that they have exhausted their natural supply of labor and have been forced to employ, not only unskilled labor, but even ignorant labor. This means that there are many men today running lathes, shapers, drills, screw machines and the like who have practically no knowledge of them, and upon these men is exerted a constant pressure by their foremen to produce—to get out the work.

Even although they may be told by their foreman in regard to the general care of their machines, such operators do not appreciate the harm that may come from a lack of oil in the spindle bearings, from using a slide that has been gibbed up far too snugly, from a failure to keep ways and other bearing surfaces clean, and from the warping strains from setting up bolts and screws too tightly. Yet it is unnecessary to point out the detrimental effect of these things upon the machine itself.

This condition is unfortunate, to put it mildly, from both the viewpoint of the machine-tool user and the machine-tool manufacturer.

The deterioration of the machine through ignorant use and lack of proper care means a shorter life and increased expenses for repairs, thus a direct money loss that probably is not nearly compensated for in any way.

It is easy for the operator to blame the machine for break-downs and wear, and it is easy for his foreman to accept this plea, take a similar position with his superintendent and attempt to discredit the machine tool and its manufacturer, a situation that is obviously unjust.

Touching directly upon these points, we quote two paragraphs from a letter received from the general manager of a prominent machine-tool building firm.

"This condition, of course, causes machine tools to be broken down and badly cut up for lack of oil, entirely on account of the ignorance of the operator, and unfortunately when these break-downs are reported to foremen, they are usually blamed on the machine, and the foreman, who is a busy man, does not take time to investigate the true conditions; consequently the manufacturer is made to suffer.

"I had a man tell me yesterday that his foreman told him not to waste time oiling his machine; that what he wanted was lots of work, and the machine must be driven to the limit of its capacity without stopping for anything, and, of course, you can readily understand what the final result is going to be."

This outlines a situation that demands action. The machine-shop foremen should see to it that their machine equipment is properly cared for, and if they are under the necessity of employing unskilled help, it may be necessary to select someone to do nothing but look after the oiling, adjustment and general care of the machines and not trust these things to machine operators. And, to pass along the responsibility, a superintendent should know whether or not the failure, or apparent failure, of a machine tool is due to improper design, material or workmanship, or to improper care and abuse.

CIRCULATION STATEMENT

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February 10..... 24,000
February 17..... 23,000

This paper reaches 39,250 *separate readers each month and* 24,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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Expert Machine-tool Operators in Europe

The special talents, that make, on the one hand, an able salesman and on the other a first-class machinist, are different; yet the expert machinist is often a most important member of the successful American machine-tool selling organization. To be sure, there is a tremendous advantage in a union of expert mechanical knowledge and trained salesmanship, and there are men who combine these qualifications. Such men occupy a position that is more than that of salesmen or machinists. They are consulting production experts, advising the plants which buy their machinery as to ways and means to increase their output, because of their superior knowledge of what to do and how to do it on their machines.

The value of trained machinists and demonstrators to an American selling organization in foreign countries is touched upon by Captain Carden in a report printed in the *Daily Consular and Trade*

Reports of January 8, dealing particularly with the situation in France. Writing of an interview with Mr. Benét, president of the American Chamber of Commerce in Paris, Captain Carden states: The representatives of American tool builders should be expert machinists. Business must be sought out, and most European manufacturers do not know their own needs; expert demonstrators understanding the full capacities of the machines they represent are needed to impress the facts on foreign shop officials.

In another paragraph attention is called to the German practice of exploiting German products abroad through Germans. This has had a wonderful influence upon the development of German commerce, and today German expert traveling agents can be found in all parts of the world, speaking the language of the country, adapting themselves to the local customs and sending home information that will permit their principals to more effectively cater to the foreign requirements. How many Americans are abroad in a similar capacity?

It is not essential that American expert demonstrators should speak the language of the country to which they are going when they are first sent out; for a knowledge of the language can be acquired, and it should always be remembered that a good tool demonstration largely talks for itself.

To be sure, the value of expert demonstration has long been recognized and made use of in this country, and why shouldn't the same course bring results in a foreign country?

The Machine Tool Inventory

The lack of uniformity in taking and keeping machine-tool inventories in machine shops is well known. All conditions can probably be found from a case where the machine tools are carried on the books year after year at their cost price plus a charge for freight, cartage and erection, to the other extreme where an amount is charged off each year as depreciation sufficient to pay for the tools in three to five years. Neither method gives an adequate idea of the real value of the machine-tool equipment at any time; that is, the amount the equipment would bring under normal market conditions if sold as second-hand machinery.

To be sure, the relative prices of new and second-hand machinery fluctuate with business conditions. In support of this contention we have but to recall the year 1906, and such incidents as the sale of the equipment of the Shaw Machinery Company, of Lowell, Mass., where second-hand machine tools sold for higher prices than the quotations on new machines of the same style and make. The delivery was all important.

Because of these fluctuations in the prices of second-hand machine tools, it is impossible to establish a method of charging off depreciation, so that the inventory value of a machine-tool equipment shall show closely its real value as second-hand equipment at any moment. We recently saw a report prepared from the records of a large machine shop, showing the cost price, inventory valuation and selling price of a large number of machine tools that were sold second-hand after they had been used for several years. In the majority of cases the selling price was several times greater than the inventory valuation, and this was particularly true of machine tools that had been in the equipment for some time. If the same conditions held for the machines in use as held for the majority of these that had been sold, it is evident that the inventory was many thousand dollars less than the market value of the equipment.

Such an inventory may be "on the right side," but is it wise? Of course, the difference between the inventory and the cost has been figured into the expense burden and returned to the firm through that channel. But if for any reason an inventory was needed as, in a merger, or the like, would not a new one be taken at once based on prevailing market prices?

Ingersoll Rand Managers Meeting

The annual conference of managers and agents of the Ingersoll-Rand Company was held in New York from February 1 to 5 inclusive.

Tours of inspection were made to the several plants of the company, and social features were arranged, including a banquet and theater party.

Reduced Duties on Machine Tools

The new commercial treaty with Germany which has been under negotiation for some time, and has finally been ratified, provides among other things, a reduction of duty on all American machines for working metals, wood or stone, to the minimum rates applicable, instead of the general or maximum rates heretofore imposed. Other clases of machinery have also been placed under lower rates.

As an example of the reduction effected by the new treaty, a machine weighing 550 pounds, or less, carries a rate of $2.86 per 220 pounds, whereas under the former schedule $4.76 per 220 pounds was imposed.

Reciprocal rates had been made on German products entering this country.

PERSONALS

Items For This Column Are Solicited

A. Falkenau, formerly president of the Falkenau-Sinclair Machine Company, has associated himself with Geo. K. Hooper, industrial engineer, New York City.

Ellis H. Deidrick has been appointed foreman of the tool department in the Lehigh Valley railroad system shops at Sayre, Penn., succeeding Henry Otto, recently resigned.

Arthur C. Hoefinghoff and George C. Kimmel have formed the firm of Cincinnati Grinder Company, Cincinnati, Ohio, and will build heavy, manufacturing, universal grinders.

Fred A. Bigelow has been made manager of the Cleveland branch of the Carpenter Steel Company. Mr. Bigelow was formerly the representative of this company in New England.

John A. Bensel, chairman of the Board of Water Supply, of New York City, was elected president of the American Society of Civil Engineers at its 57th annual convention, held on January 19.

F. C. Thornley, for two years superintendent of the Builders' Iron Foundry, Providence, R. I., has accepted the position of general superintendent with the Robins Conveying Belt Co., Passaic, N. J.

W. Bryan, superintendent American Ship Windlass Company, Providence, R. I., will sail shortly for Buenos Aires, Argentina, to establish branch works in that country. Mr. Bryan expects to be away four months or more.

Harry Croninger has accepted the position of manager at the American Locomotive Company's plant at Providence, building the Alco cars. Mr. Croninger was formerly with the Pennsylvania Auto-Motor Car Company.

Bernhard Gustafson has associated himself with the Cummings Machine Company, New York, and has succeeded C. N. Talbot as a director thereof. This company has obtained the manufacturing rights of Mr. Gustafson's patents on printing machinery.

W. H. Dotzauer, foreman of various departments of the Remington Arms Company, Ilion, N. Y., during the past 15 years, has recently resigned to take up the duties of superintendent of the automobile hub department of the Weston-Mott Company, Flint, Mich.

Arthur N. Talbot, of the University of Illinois, was awarded the Chanute medal, an annual prize offered by the Western Society of Engineers for the best paper presented to the society in the field of civil engineering. Professor Talbot's paper was entitled "Tests of Cast Iron and Reinforced Concrete Culvert Pipe."

NEW TOOLS and MACHINE SHOP APPLIANCES

Showing New Ideas in Machine Shop Equipment that make it possible to do better work at a reduced cost

The Parker Transmission Device

Fig. 1 shows this device as applied to a 16-inch specially built F. E. Reed lathe. The transmission device itself is hung from the ceiling and the control is in the apron of the lathe. The one shown herewith gives four forward speeds of the spindle from about 90 to about 500 revolutions per minute and one reverse at 135 revolutions per minute with the driving pulley making 140 turns per minute. The transmission is supported from two hangers bolted to stringers. At the right it hangs on two pivots, one of which shows plainly about the center of the driving pulley. At the left a single vertical pivot is used, so that the device is hung at three points. This has been running over two years and has never had a wrench on it nor even been oiled. While the halftone shows its application to a specially built lathe, it is readily fitted to existing lathes, in which case the vertical rod becomes the shifter and the works in the lathe apron are dispensed with.

Referring to Fig. 1, the pulley at the right on the transmission is belted direct to the line shaft. Between it and the driving pulley to the left are a series of gears and a shock absorber without which the efficiency of the device would be materially lessened. The gears in the transmission are brought into action by means of two sliding keys which are actuated by a rack and yoke to which they are pivotally connected. The rack is moved by a pinion which is formed on the upper end of the vertical shaft shown in the halftone. This vertical shaft is provided with universal joints and a sleeve so that the lathe or other tool can be placed at any convenient point and moved about to bring it in line with the transmission.

The ball-shaped casting at the bottom of the vertical shaft contains a pair of miter gears, one on the vertical shaft, the other on the horizontal splined shaft below the feed rod. Mounted on this splined shaft and held in position by suitable brackets in the apron is another of a pair of miter gears meshing with a miter gear which is in geared connection with the lever in the hand of the operator.

With this lever in the position shown, that is approximately at the top, the lathe spindle is in motion either in one of the four forward speeds or in the reverse. With the lever at a position approximately 180 degrees from that shown the lathe spindle is stopped.

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

A full and detailed description will be given—when of special interest and it can appear here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

It will be observed that there is a small segment secured to *the saddle* above where the operating lever is centered. This arc is graduated for the four speeds and the reverse and has blank spaces between. To the left of the operating lever is an index pointer geared to the operating lever by means of a spiral. This pointer indicates to the operator what speed is being used.

The Apron

While the overhead works is the important part of this device, it will probably simplify matters to begin at the apron, from where the device is governed, and see just what takes place when the operating lever is turned either in one direction or the other, for it swings in a circle either forward or backward.

Fig. 2 shows partial views of the apron. *A* is the operating lever which imparts motion through the pinion *B*, gear *C*, gear *D*, miter gears *E* and *F* to the splined shaft *G*, which is the lower shaft shown

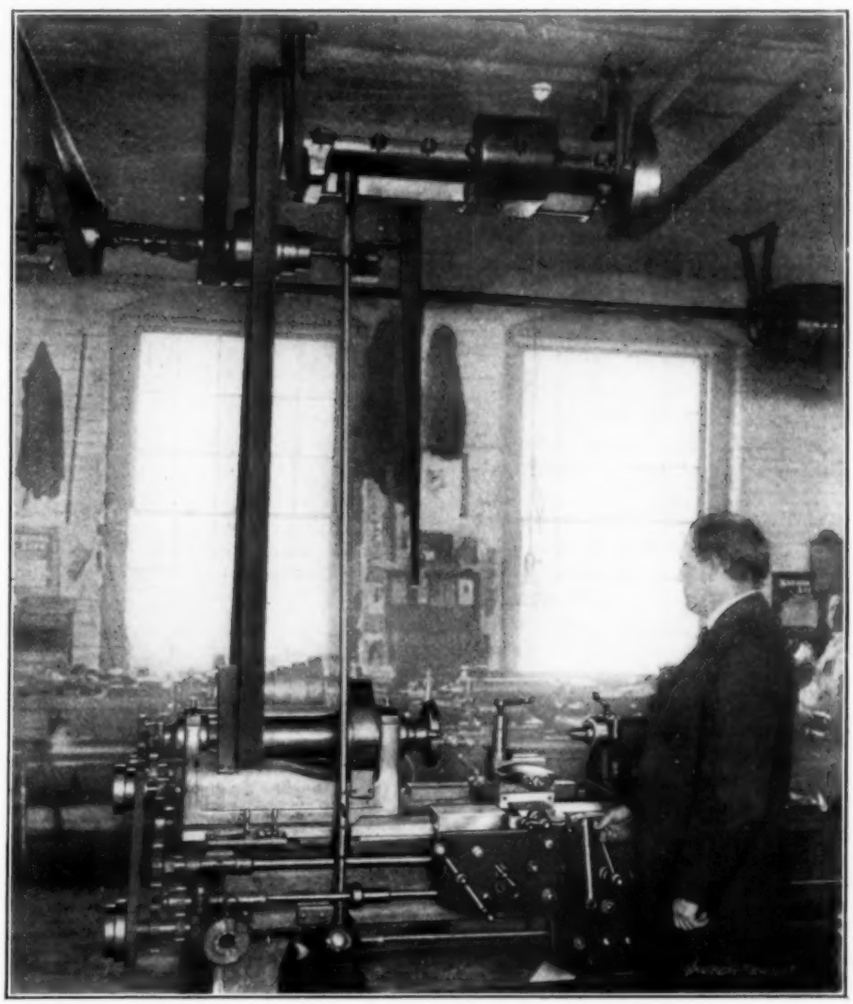


FIG. 1. THE PARKER TRANSMISSION APPLIED TO A 16-INCH REED LATHE

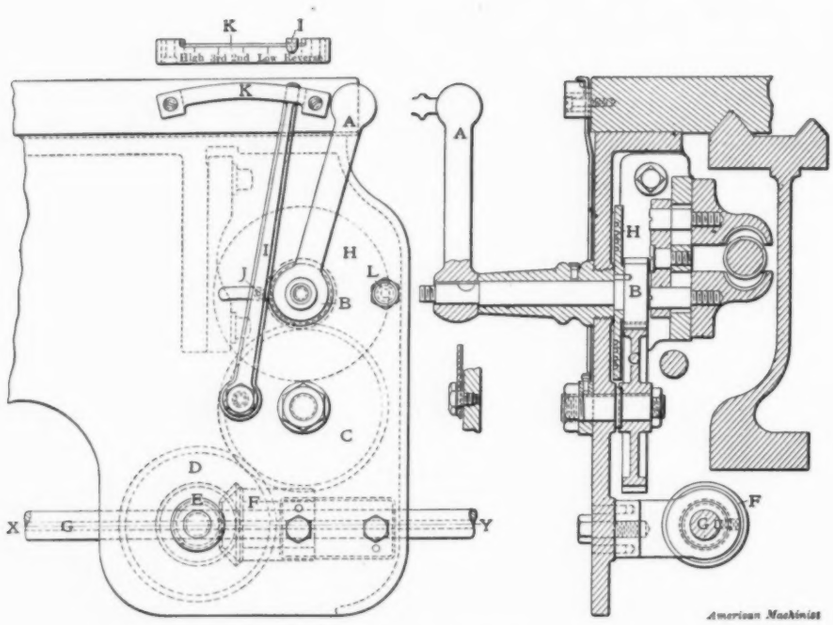


FIG. 2. APRON DETAILS

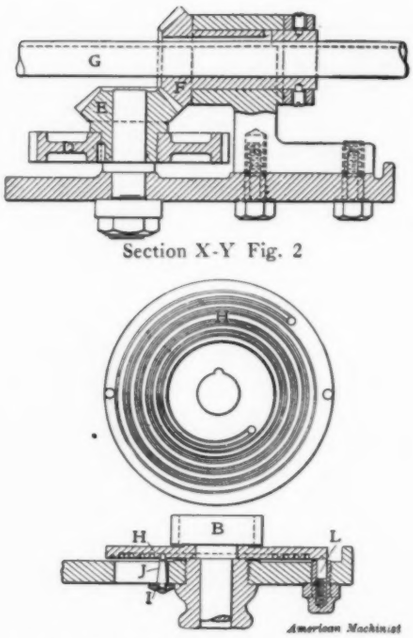


FIG. 3. DETAILS OF SPIRAL AND APRON

in Fig. 1. Keyed to the pinion *B* is the spiral *H*, which imparts a limited amount of motion to the pointer *I* through the pin *J*, which is secured in *I* and reaches into the spiral groove in *H*. This pointer indicates on the arc *K*, which gears, in the transmission device overhead, are operative. In order to retain the operating handle *A* either in the up or down positions, that is, to hold the transmission in or out of gear, the edge of the spiral *H* is spotted with a drill at two diametrically opposite points and the spring-actuated pin *L* being forced into these spots holds the handle in either position. Fig. 3 shows at the top a section through *X Y*, Fig. 2, and at the bottom the detail in section of the spiral *H*, the pin *J*, the pointer *I* and the spring pin *L* and their functions. As stated before the splined shaft *G* transmits its rotation to the vertical shaft, the upper end of which terminates in a spur pinion.

THE TRANSMISSION

Fig. 4 shows the transmission in plan, vertical section and end elevation.

A is the driving pulley, which is belted to a pulley on the line shaft. It is secured to the sleeve *C*, which is a running fit on the end of the shaft *D*.

Between the sleeve *C* and the shaft *D* is situated the shock absorber *B* shown in Fig. 5. The shafts *D* and *G* are provided with very deep key-ways in which the sliding keys *E* operate. These keys are provided under the head with a spring shoe which forces them outward when not depressed by coming in contact with the inner edges of the washers *O*. Without the shock absorber, the sliding of these keys from gear to gear while the machine is in motion would result in breakage or excessive wear, and for that reason the shock absorber was applied at a suitable point between the driving pulley *A* and the driven pulley *N*. At *B*, Fig. 5, is the wedge, *C* is the end of the sleeve provided with two wedge-shaped sliding blocks *D D*, which are forced together by the two springs *E*. When the key *E*, Fig. 4, is thrown suddenly into engagement with any pair of the gears, the sleeve *C*, Fig. 4, will, owing to the resistance of the gears, etc., advance toward the wedge-shaped piece *B* and this coming into engagement with the two spring-controlled wedges *D D*, the shock of sudden starting will be absorbed and the shaft *D*, Fig. 4, will be brought into operation gradually. The action of the two sliding pieces *D* upon the wedge *B* on releasing the key *E* from engagement

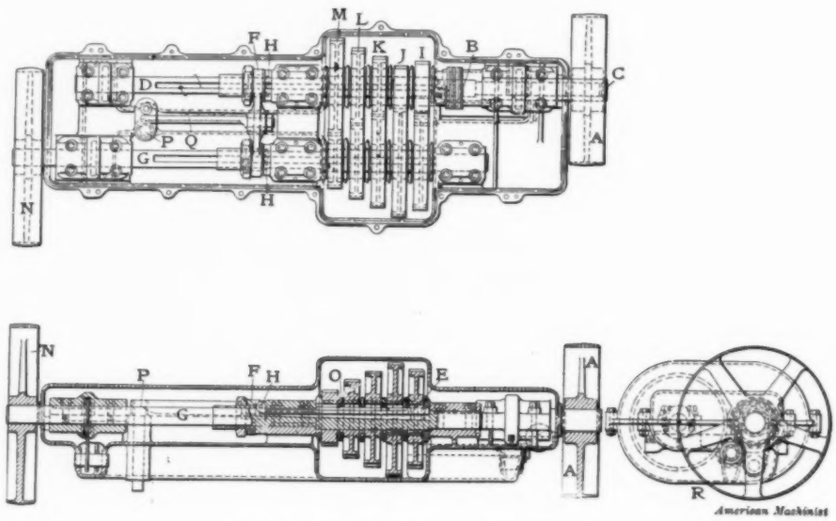


FIG. 4. PARKER LATHE TRANSMISSION

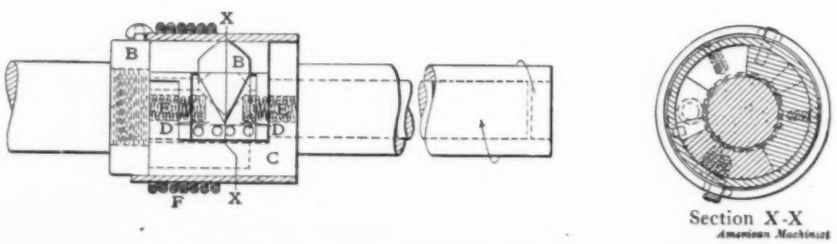


FIG. 5. DETAIL OF ASSEMBLED SHOCK ABSORBER

with the gears, is to force it out of engagement with them. This action is further assisted by the coil spring *F*, Fig. 5, one end of which is fastened to the wedge piece *B* and the other to the sleeve *C*. The yoke *F* is actuated by the rack *Q*, which is in turn moved by the pinion *P*, which is, as before stated, the top of the vertical shaft.

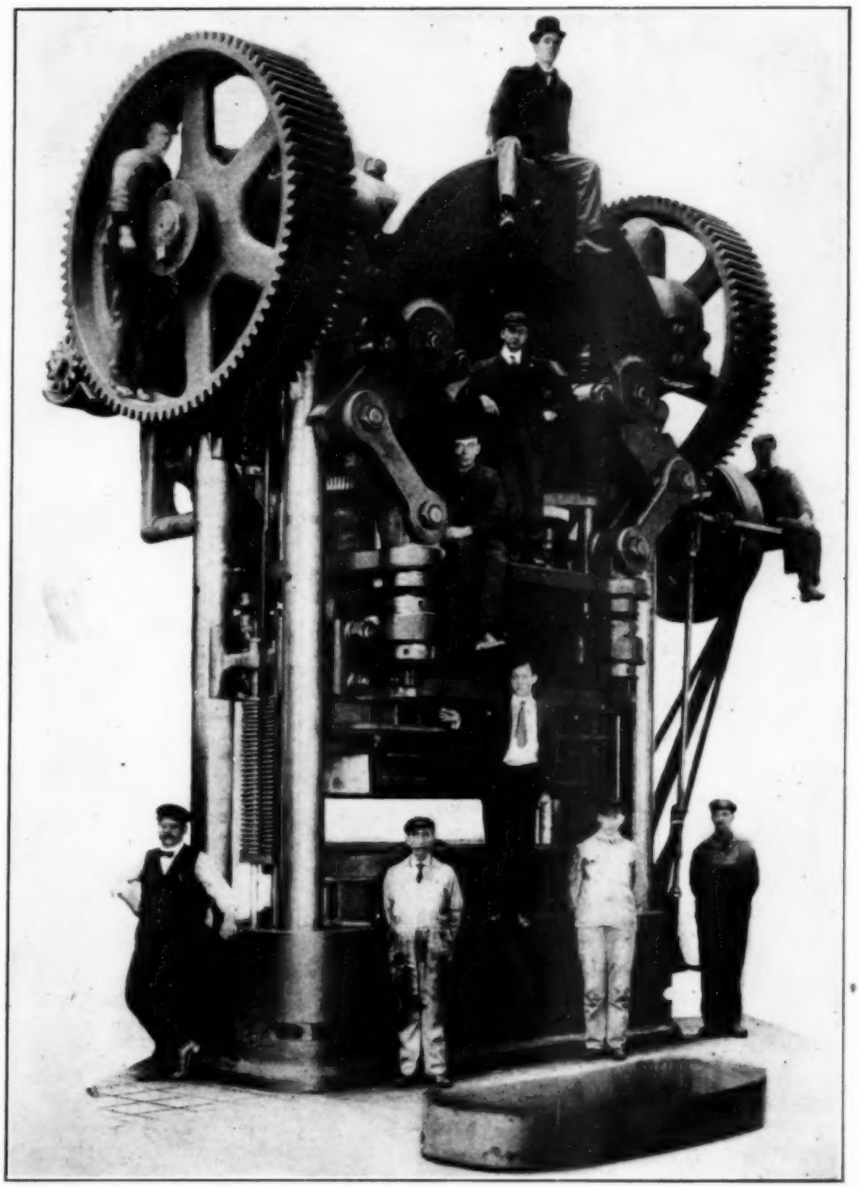
The reverse is obtained by an idler between the gears *I* in Fig. 4.

The transmission was originally designed as a part of a book-binding machine but it has been applied to two lathes and to an automobile. The automobile has made over 17,000 miles since the transmission was put on without repairs and the wear on the keys is less than 0.005 inch.

While the device shown permits of but four forward speeds and one reverse, it is obvious that any number of forward or backward speeds can readily be provided. It is manufactured by the Parker Transmission and Appliance Company, 25 Harrison avenue, Springfield, Mass.

Huge Toggle Drawing Press

The Ferracute Machine Company, of Bridgeton, N. J., has just constructed the large toggle double-action drawing press, shown in the accompanying illustration, which is believed to be the largest press of the kind ever built. It is 20 feet, 2 inches high; occupies a floor space of 18 feet 9 inches by 9 feet, 3 inches; weighs 100 tons and gives a ram pressure of 1500 tons. It has been built particularly for the production of seamless burial caskets of the largest size, drawn from sheet steel one-sixteenth of an inch thick, but is equally well adapted for other large shells such as automobile bodies, bath-tubs or metallic boats. The bed weighs 18 tons. The round steel columns are 10 inches in diameter, supporting the upper framework, serve as slide-bearings for the outer ram and take the tensile stresses. The crank shaft is 15 inches in diameter and weighs 5 tons and is driven by cast-steel twin gears, each 7 feet 2 inches diameter by 1 foot, 6 inches face and weighing 4¼ tons each.



HUGE TOGGLE PRESS

There are four sets of these toggles giving pressure to the outer ram at four points. Rollers on studs projecting from the plunger bear against the upper toggles, causing them to straighten out when the plunger descends, forcing the outer ram down. As the plunger rises, after a stroke has been made, similar rollers on the other side of the toggles strike projections at the "knee-joints" of the toggles, causing them to resume their angular position, the outer ram being lifted by steel springs as soon as the toggles are tripped.

The plunger has **32** inches stroke and the ram 16 inches, making it possible to draw work of very nearly that depth. The adjustment of both ram and plunger is 8 inches. The press is driven by a 125-horsepower motor and contains a powerful friction clutch by means of which the operator has perfect control at all times, being able to start and stop the machine at any part of the stroke. The ratio of gearing is 1 to 300, the press making about 1½ strokes per minute. A positive knockout is connected to the ram by rods running up through the bed. The press was designed by Oberlin Smith.

A Screw Making Machine

The International Machine and Screw Company, Springfield, Mass., has built a machine for producing screw blanks. The machine will not be put on the market as the company intends to manufacture and sell screws.

The wire from a coil is fed into the machine where it is cut off by rolls similar to pipe-cutting rolls. The piece cut off is then taken automatically to a series of cam-like rolls which roll the body-part of the screw down to size. The head remains the size of the original wire. The blanks then are forced into sizing dies, after which they are put through the thread-rolling and slotting operations in other machines. Formerly the machine produced the finished screw, but it was found more economical to have separate machines for threading and slotting. The slotting is done on a punch press, the slot being forced in instead of cut out. It is said that screws thus produced are stronger than those the heads of which are upset.

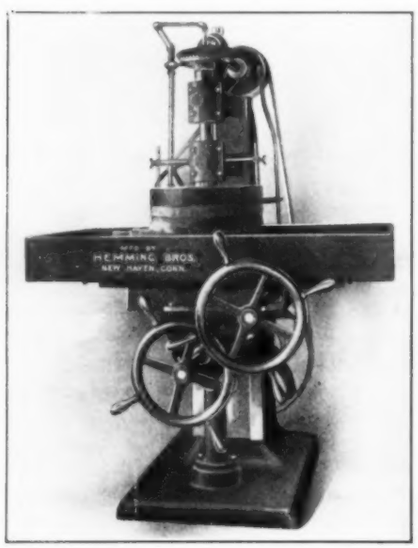
Die and Surface Grinder

The machine shown in Fig. 1 is built particularly for grinding and sharpening dies but can be used for grinding any flat work. The lower hand wheel shown in the cut is for elevating the knee carrying the work table. This handwheel is graduated to read to thousandths but fractions of thousandths can be readily estimated. The upper handwheel is for traversing the table. On die grinding the operator with hand feed can *feed* what the machine is doing and instantly either increase or decrease the rate of feed as experience dictates.

The table is 12 inches wide by 24 inches long and work of these dimensions can be handled by the machine. T-slots are provided for clamping work or chucks to hold the work.

No cross feed is provided as with the ring-shaped wheel it is not necessary. The table is surrounded by a rectangular trough which catches the cooling medium, soda water, and therefrom it draws to the column of the machine which acts as a reservoir from which it is taken by a pump, with which the machine is provided, and delivered to the abrasive wheel.

The drive is by belt from the pulley at the back of the machine through the bevel gears to the spindle. The wheel is of the ring type 12 inches in diameter of a special grade to avoid heating the work as much as possible, the same grade of wheel being used on this machine as is used by the firm on their cutlery grinders which handle their knife blades without drawing the temper. A rubber shield on the wheel effectually protects the operator from being drenched by the lubricant. The machine can be provided with magnetic chucks and automatic feed if desired.



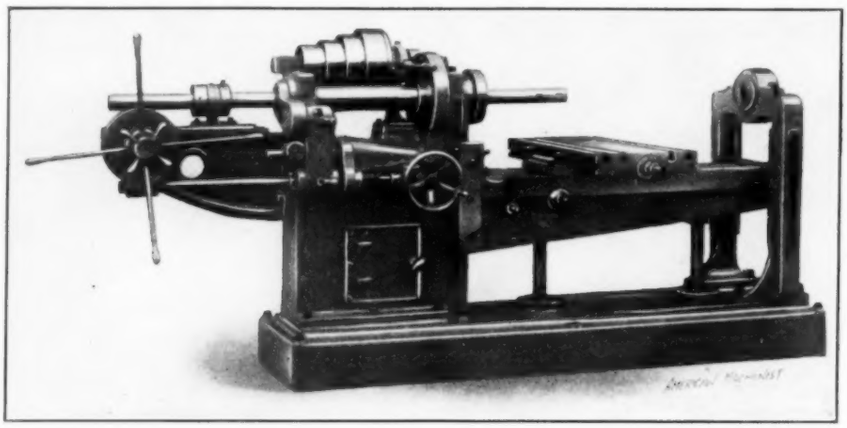
DIE AND SURFACE GRINDER

This machine is built by Hemming Brothers, New Haven, Conn.

Improved Horizontal Boring Machine

The illustration shows the latest design of horizontal boring and drilling machines made by the Binsse Machine Company, Newark, N. J. The pilot-wheel handles are lengthened to bring the rapid bar movement within easy reach of the operator and positive feed gears inclosed in the gear box shown, takes the place of the friction disk feed formerly used. With only ten gears in the box, eight feeds are secured which can be changed with the machine in motion.

The yoke is provided with a hinge cap to aid in easily removing the bushing and boring bar, the boring bar has been increased to 2¾ inches in diameter and there are other minor improvements in both the cross piece carriage and in fastening the long work table to the head.



IMPROVED BORING MACHINE

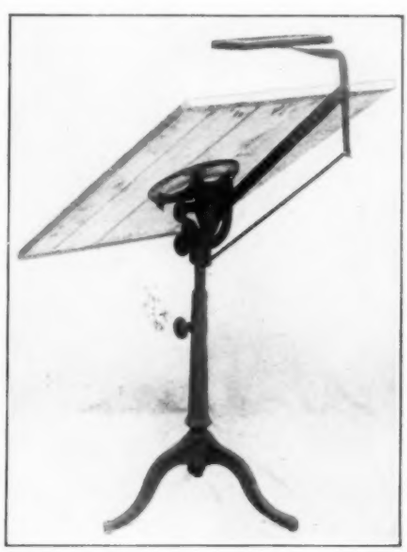
Convenient Drawing Stand

In the accompanying halftones a handy and inexpensive drawing-board stand for both office and home use is shown. The board itself has an iron ring screwed to its under surface, and into slotted pockets in the ring, fit the heads of three bolts at the ends of a three-pointed swivel frame. Wing nuts on the bolts provide for easily removing the board and its ring from the frame.

Provision is made by a taper plug and socket, so that the three-pointed frame, together with the drawing board, may be rotated, while horizontal trunnions allow the frame and board to be tilted to any angle. It will be readily seen that rotation of the board does not affect the hight or tilt, and this makes the rotation feature particularly desirable for cross-hatching, etc.

Two hand wheels control the tilt and the hight of the board, while a system of links supports a shelf just above the rear edge of the board and always in a hori-

FRONT VIEW



REAR VIEW SHOWING ATTACHMENT

A HANDY DRAWING BOARD STAND

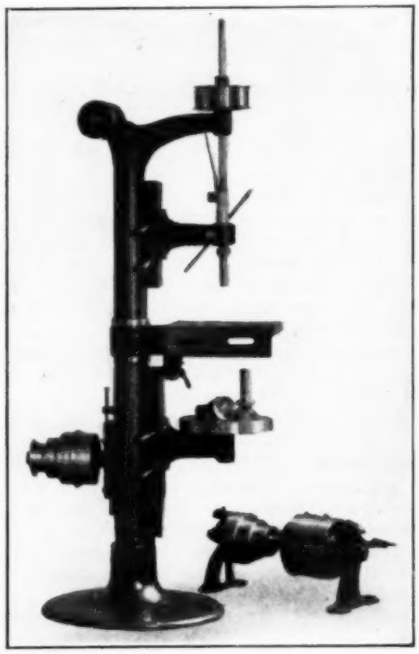
zontal position. This shelf is for drawing instruments, ink, etc.

By the slotted pockets and wing bolts, it is particularly convenient to change drawings by changing boards, thus obviating the trouble of removing and replacing thumb tacks and especially the difficulty of readjusting the lines to the T-square. It is necessary only to provide one cast-iron ring for each board used, each of which will fit the three-pointed swivel frame, making it possible to employ a number of boards for one supporting stand.

This device is made by the Shartle Brothers Machine Company, Middletown, Ohio.

New Toolmakers' Drilling Machine

We show herewith a new machine brought out by H. G. Barr, of Worcester, Mass. This machine is designed on the lines of their No. 4 machine and is intended to supply the demand for a heavier machine of this type. This style machine has been found very desirable for the tool room or any department where special drilling is being done.



TOOLMAKERS' SENSITIVE DRILL

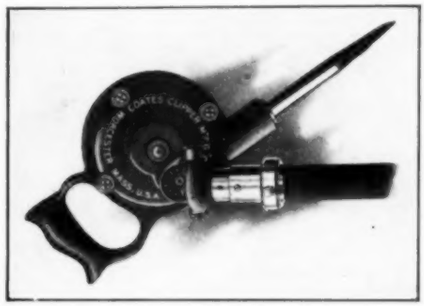
All pulleys are turned on the inside, giving perfect balance. All sliding surfaces are scraped to fit and frosted. Drill drift is attached by a chain. The square table is 13x14 inches, swings around the table and will tilt to any angle. It is held in a horizontal position by a taper dowel pin. The round table is 12 inches in diameter and can be removed from its supporting bracket to admit the cup and crotch centers. Both tables are provided with binder handles for the purpose of securing them in any desired position.

The spindle is 35 inches long, is made from a forging and is 1 inch in diameter; has a No. 2 Morse taper, travels 5 inches, has ball-bearing thrust collars at lower end of quill; fiber collar, splined collar and nut at top of quill; steel rack and pinion; self-fastening feed lever, which does away with set screws or thumb screws. The belt tightener shown is provided on all machines and allows for a take up of 4 inches in the belt.

The limit of alinement is 0.00075 inch in 10 inches, this being the length of arbor used in testing the machines. This machine is known as their No. 7 drill and weighs 515 pounds with countershaft.

A Mechanical Chipping Hammer

The illustration shows a new chipping hammer which has just been brought out by the Coates Clipper Manufacturing Company, Worcester, Mass., and which is entirely mechanical in its operation. Power can be taken from any desired source through the flexible shaft and the mongrel bevel gears drive and act as a universal joint at the same time, the hammer being supplied with a small electric motor for driving the shaft as being the most portable and convenient means of obtaining power.



MECHANICAL CHIPPING HAMMER

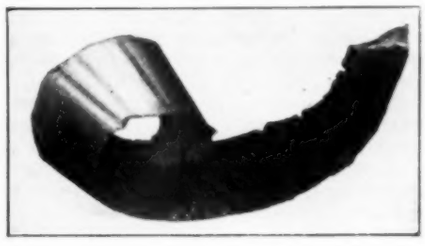


FIG. 2. ACTUAL SIZE CHIP

The operation is extremely simple and consists of a number of revolving hammers striking the head of the chisel several thousand blows per minute. It weighs no more than the usual chipping hammer and is entirely free from valves and springs. An idea of the work it can do can be obtained from the steel chip shown in Fig. 2, which is actual size. It has been very carefully tried out on various kinds of work and given good satisfaction in every case.

The National "Case" Die

The National Machinery Company, Tiffin, Ohio, is making what is known as a "case" die for its bolt cutters. This consists of a separate body or case, of large dimensions to secure good bearing surfaces, which protects the sides of the chaser itself and prevents chips being drawn into the head slots when the die is open.

This form requires 30 per cent. less cutting steel, allows more resharpenings and permits a deep throat being ground on the cutter. Only the cutter has to be renewed and a substantial reduction of cost for upkeep is claimed.

A Cement Pulley Covering

Pulley coverings of various kinds have long been used, usually consisting of leather, canvas or paper. The American No-Slip Cement Company, Boston, Mass., is making a cement known as "Palium," which is applied directly to the pulley and forms a coating of from 1/16 to 1/32 of an inch thick, requiring twelve hours to harden. It can be applied to all kinds of pulleys, and it is claimed that it does not glaze, is fire proof, a non-conductor of electricity, prevents slipping and will last for years. It is also recommended for friction disks, clutches, and any place where good frictional contact is desired.

Revision of Scrap Iron Ruling

The Treasury Department has modified its former ruling in regard to the duty on scrap iron, as set forth in a letter to the collector of customs of Philadelphia, under date of January 28. We quote:

"Since the publication of the department's instructions to you of October 23, 1909 (T. D. 30,063), relative to scrap iron and scrap steel, the department has received many requests from persons interested in the business of remanufacturing these commodities for further consideration thereof.

"In determining the interpretation to be placed upon paragraph 118 of the tariff act of 1909, the important point to be borne in mind is the intention of the Congress, as indicated by the change in the rate of duty upon scrap from $4 to $1 per ton. It is not only a matter of common knowledge, but also within the specific knowledge of the department, that Congress intended scrap iron and

scrap steel to be imported with a duty of $1 per ton; and that Congress did not intend to permit the entry as scrap, of iron and steel not really waste or refuse. In order to give full effect to the primary intent of the statute—*i.e.*, the lowering of the tariff on scrap, the defining clause must be interpreted in a manner that will not render nugatory the principal clause immediately preceding it. In other words, a proper and just construction demands that more stress be laid upon the clause by which the duty is lowered than upon the clause excepting certain materials from the operation of the paragraph. The department is of opinion that the phrase, 'Fit only to be remanufactured by melting and excluding pig iron in all forms,' was intended by Congress to be a more accurate definition of the term, 'scrap iron and scrap steel,' than was contained in the act of 1897, and was not intended in any way to be a further limitation thereof.

"After a careful investigation into the methods of remanufacturing waste or refuse iron or steel now in operation, the department is of opinion that all scrap iron and scrap steel is dutiable at $1 per ton except such as can be profitably remanufactured by a process of rolling, hammering or cutting, or any other process which does not include the complete change of form of the material by fusion caused by the application of heat. T. D. 30,063 is hereby modified accordingly."

INCREASING · SHOP · CAPACITIES
where More Tools will be needed

Henry Horn, Tacoma, Wash., will erect a shingle mill.

The Veitch-Matthews Company will erect a foundry at Bessemer, Ala.

The London Machine Tool Company, Hamilton, Ont., will extend its plant.

The Southwestern Furniture Company, Topeka, Kan., is to enlarge its plant.

Mr. Aldrich, of Donnelly, Minn., is building an addition to his blacksmith shop.

The Ball Multo Spark Plug Company may erect a factory at Aberdeen, S. D.

The Wilson Mercantile Company, Wausau, Wis., will erect a cold-storage plant.

The Fawkes Auto Company, Minneapolis, Minn., will erect a $45,000 garage.

Cortes & Co., Prat 18, Valparaiso, Chile, are interested in all kinds of machinery.

The Van Orden Corset Company, Newark, N. J., will enlarge its power plant.

The plant of the George C. Moore Wool Scouring Company is to be enlarged.

The Dakota Portland Cement Company will erect a plant at Chamberlain, S. D.

The Plymouth Veneer Company, Sheboygan, Wis., will erect a three-story factory.

The Seattle Lighting Company, Georgetown, Wash., will expend $125,000 in improvements.

The International Harvester Works will make additions to its plant at Hamilton, Ont.

The Canadian Drawn Steel Company, Hamilton, Ont., will make additions to its plant.

The Zenith Fuel Saver Company, of St. Paul, Minn., will erect a plant at Willmar.

Armour & Co., of Chicago, propose establishing a fruit canning plant at Ridgely, Md.

The Velte Foundry and Machine Company, Pittsburg, Penn., will erect a new plant at Mars.

The Eureka Cedar Lumber and Shingle Company will erect a sawmill, at Hoquiam, Wash.

The Sea Beach Packing Company, Aberdeen, Wash., will make improvements to its plant.

The National Welding and Manufacturing Company, Buffalo, N. Y., will enlarge its plant.

The Abrasive Material Company, Philadelphia, Penn., has purchased site for a new plant.

The Moline (Ill.) Foundry Company will erect an addition to its plant and double its output.

The lathe and lumber mill of Frank and A. D. Clements, at Tomahawk, Wis., was burned.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The blacksmith shop and feed mill of Moore & Geddes, Bergen, N. D., was destroyed by fire.

The Baur Ice Cream and Candy Company, Denver, Colo., will erect a new four-story factory.

The Continental Motor Manufacturing Company, Muskegon, Mich., will erect a new factory.

The plant of the Gilsum (N. H.) Woolen Company was destroyed by fire. Loss, about $40,000.

The Inter-State Roofing Company, Anniston, Ala., proposes doubling the capacity of its foundry.

The John S. Bradstreet Company, Minneapolis, Minn., will build an addition to its cabinet shop.

The M. H. Sprague Lumber Company is erecting an addition to its sawmill at Washburn, Wis.

The Wilkes-Barre (Penn.) Slag Roofing Company will erect a new plant at Riverside, Penn.

The Lidgerwood (N. D.) Mill Company has applied for a franchise to install an electric-light plant.

The Hall (Tenn.) Light, Water and Ice Company will build a new ice plant and bottling works.

It is expected that the town of Aurora, Minn., will install a lighting system in the near future.

The M. J. Gibbud Manufacturing Company, New Haven, Conn., will erect a new woodworking plant.

The plant of the National Mill Supply Company, Paterson, N. J., was burned. Loss, about $20,000.

The Hamburg (Penn.) Manufacturing Company, manufacturing chain hoists, will enlarge its plant.

The Oregon & Washington Railway Company is erecting repair shops and roundhouse at Argo, Wash.

Fire destroyed the cold-storage plant of Duggan Brothers, 287-293 Broadway, Williamsburg, N. Y.

The Oregon Wood Distilling Company, Portland, Ore., will establish a plant at Aberdeen, Wash.

The Beaver Dam Mills, Edgefield, S. C., will erect a new cotton mill of about 45,000 spindle capacity.

The C. A. Krause Milling Company, Milwaukee, Wis., will erect a five-story flour mill to cost $250,000.

The Wisconsin Manufacturing Company, Jefferson, Wis., will erect another addition to its chair factory.

The Eagle Roller Mill Company is planning the erection of a rye and cornmeal mill at New Ulm, Minn.

The General Motor Company, 103 Park avenue, New York, will erect a factory at Weehawken, N. J.

The Western Sash and Door Company, Kansas City, Kan., will probably erect a branch plant in Hutchinson.

The woodworking factory of Hamilton & Gay, St. John, N. B., was destroyed by fire. Loss, about $50,000.

Chambers Brothers Company, Philadelphia, Penn., making brick machines, will erect an addition to its plant.

Fire destroyed Bennett's Embroidery Factory at Fairview, N. J. Loss on machinery estimated at $50,000.

The plant of the Munroe Steel and Wire Works, at Winnipeg, Manitoba, was destroyed by fire. Loss, $40,000.

The Colorado Ice and Cold Storage Company, Denver, Colo., will build a one-story addition to its ice plant.

The McKusick-Towle Company, Minneapolis, Minn., confectionery manufacture, will erect a new five-story factory.

The Raymond (Wash.) Transfer and Cold Storage Company will erect a new building and install an ice plant.

The Progressive Manufacturing Company, Torrington, Conn., will move its motor department to Newark, N. J.

Swift & Co. has taken out permit for the erection of a cold-storage plant at New Orleans, La., to cost $89,000.

The Liquid Carbonic Company, Minneapolis, Minn., will erect a four-story factory next fall to cost $115,000.

The Peerless Motor Car Company, Cleveland, Ohio, has awarded contract for construction of a new foundry.

The Chicago, Burlington & Quincy Railroad is contemplating the erection of a new roundhouse at South Omaha, Neb.

The Glazed Cement Sewer Pipe Company,

Tacoma, Wash., is considering the establishment of a plant at Aberdeen.

The Kilbourne & Jacobs Manufacturing Company, of Columbus, Ohio, will erect a sawmill near Gauley Bridge, W. Va.

Valentine Bros., of Minneapolis, Minn., may establish a plant for the manufacture of gasolene engines at Anoka, Minn.

It has been announced that the Hamilton (Ont.) Steel and Iron Company intends to spend $1,000,000 on improvements.

The Brown-Lipe-Chapin Company, Syracuse, N. Y., succeeding Brown-Lipe Gear Company, has secured site for a new plant.

The Updike Milling Company, Omaha, Neb., is planning to increase the capacity of its mill from 500 barrels a day to 1000.

The planing mill and lumber yard of Jos. Miles & Son, at West Manayunk, Philadelphia, Penn., were destroyed by fire.

The Winkleman Lumber Company, Tacoma, Wash., is planning the erection of a sawmill of about 40,000 feet daily capacity.

The engine and boiler room of Thompson Brothers Drop Forging Company, Southington, Conn., was burned. Loss, $10,000.

E. D. Ward, Worcester, Mass., has been awarded contract to build a three-story brick carriage factory and garage to cost $25,000.

B. Bernheim & Sons Company, Philadelphia, Penn., manufacturing store fixtures, has awarded contract for a four-story addition.

The Vicksburg (Miss.) Electric Light and Power Company will build new car barns, install stokers, and make other improvements.

The Jahnke Creamery Company, Watertown, Wis., is considering the erection of a creamery and cold-storage plant at Merrill, Wis.

The Murphy Iron Works, Detroit, Mich., will erect a new foundry building for the production of gray and malleable iron castings.

The Burleigh Glove Company will establish a glove factory in the Webster-Sunderland building, Omaha, Neb. Will need equipment.

The Cleveland (Ohio) Electric Illuminating Company will make extensive improvements including the erection of a large new power house.

The Larson Cold Storage Company, Boise, Idaho, recently incorporated, has commenced the erection of a plant at Ninth and Myrtle streets.

Fire destroyed the machine, carpenter and blacksmith shops of the Goldfield Consolidated Mines Company, Goldfield, Nev. Loss, about $10,000.

The blast-furnace plant of the Delaware River Steel Company, at Chester, Penn., was damaged by fire to the extent of about $100,000.

The Wyoming Coal Mining Company, Monarch, Wyo., will install a locomotive haulage system next April. This is to be gas, air or electricity.

The Heppenstall Forge and Knife Company, Pittsburg, Penn., is to spend $250,000 on improvements. Plans have been prepared for an addition.

The Mexican Light and Power Company, Mexico City, is about to install steel-furnace equipment, including electrical furnaces for melting, etc.

The International Machine Tool Company, Indianapolis, Ind., will shortly add to its general shop equipment. New pattern shop will also be added.

Garcia & Palacio, Plaza, Hidalgo, No. 3, Monterey, N. L., Mexico, are in the market for sawmills and machinery for sawing sleepers and railway ties.

The Mexican Steel Products and Machinery Company, S. A., Calle de Mariscala No. 1, Mexico City, is asking for quotations on ice-making machinery.

The city of Newark, N. J., is asking for bids on a new commercial and manual training school for which a number of machine tools will be needed.

The blacksmith shop of Hahn Brothers, and the iron foundry of Confer, Smith & Co., Hamburg, Penn., were destroyed by fire, causing a loss of about $50,000.

The LaPlant Tool Company, Marshalltown, Iowa, recently organized, has acquired a shop and will install equipment, including planers, lathes, drills, shapers, etc.

The Hudson Motor Company, Detroit, Mich., has closed a deal for 100 acres of land on which it will begin at once the erection of a plant to cost over $500,000.

The Northwestern Manufacturing and Plating Company will install a novelty factory in the plant vacated by the Wisconsin Art Glass Company, at Oshkosh, Wis.

The Jones Refrigerating Machine Company, 104 River street, Elgin, Ill., has decided upon a policy of expansion and would like to receive catalogs of manufacturers.

Fire destroyed the foundry building at the plant of the Lee Foundry Corporation, Anniston, Ala., and partially consumed the pattern shop. Loss, about $10,000.

Arthur C. Hoefinghoff and George C. Kimmel have formed the Cincinnati Grinder Company, Cincinnati, O., and will build heavy manufacturing universal grinders.

The Ford Motor Company, Buffalo, N. Y., has purchased the plant of the Keim Company and will make all its bearings and do all the pressed-steel work in the future.

Fire practically destroyed the plant of the Westinghouse Electric Company, at Boonton, N. J., causing a loss of about $240,000. The principal product was storage batteries.

The Chicago & North Western Railroad will build a new roundhouse at Belle Plaine, Iowa. This will contain 100 stalls and, it is said, will be the largest in the world.

The Mathie Brewing Company, Los Angeles, Cal., is open for bids on 100- to 150-kilowatt direct-connected unit for power and lighting. Martin Paulson, chief engineer.

Manuel J. Gonzales, Calle Morande No. 843, Santiago, Chile, would like particulars covering machinery for making fine clothes and shoe brushes, also shoe-polishing machines.

The Atlantic Broom Company has purchased ground at Toone and Second streets, Canton, Ohio, on which it will erect one of the largest broom factories in the country.

It is said the Merchants' Despatch Transportation Company, East Rochester, N. Y., has let contract for the construction of a new foundry for the manufacture of sheet steel.

It has been definitely decided that the Racine (Wis.) Manufacturing Company, whose plant recently burned, will rebuild in Racine. The company manufactures auto carriage bodies.

The McNaughton Foundry, Charlotte, Mich., will move its plant to Maryville, Tenn., where the company will continue to manufacture the McNaughton grate bar and other specialties.

The Wm. N. Crane Company, 16-20 West Twenty-third street, New York, has awarded contract for the construction of a plant in Greenville, N. J., for the manufacture of its gas stoves.

A new mechanical engineering school is to be established at Yale University, New Haven, Conn., to be known as the Mason Laboratory of Mechanical Engineering. Construction will begin July 1.

The Lennox Furnace Company, Marshalltown, Iowa, will double its capital stock for the purpose of making extensive improvements. An addition to its foundry is to be built next spring.

The roundhouse with seven locomotives and several cars of the Bessemer & Lake Erie Railroad, at Greenville, Penn., were burned, causing a loss of over $200,000. Roundhouse will be rebuilt at once.

The Secor Typewriter Company, Derby, Conn., which will manufacture a new visible typewriter, has completed organization with Frederick A. Richardson as president. The company is capitalized at $30,000.

A six-mill sheet plant is to be built by a number of Canton, Ohio, capitalists, headed by C. A. Irwin, formerly of the Berger Manufacturing Company. Location has not been decided on, but will probably be Canton.

Thomas L. Deisch, of Helena, Ark., has been granted a franchise for an electric-light and power plant in Elgin, Tex. This will be known as the Elgin Electric Light and Power Company. A $14,000 plant is to be erected.

The Stockbridge Machine Company, Worcester, Mass., is making extensive improvements. A two-story addition is now being built. New engine will be installed in the power plant on completion of new building.

BUSINESS ITEMS

The business heretofore conducted by the Risdon Tool Works has been succeeded by the Risdon Tool and Machine Company, Waterbury, Conn.

We are in receipt of calendars from the Arguto Oilless Bearing Company, Philadelphia, Penn., and Harrington & Richardson Arms Company, Worcester, Mass.

FORTHCOMING MEETINGS

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted — An experienced salesman for steam pumps, boilers, etc.; a good job for the right man; state experience and salary expected. Box 206, AMERICAN MACHINIST.

Wanted—A few first-class mechanical draftsmen on electrical generators, motors, etc., steady work. Apply, with references, giving experience in detail, stating wages, to Canadian General Electric Co., Peterboro, Canada.

CONNECTICUT

Wanted—Experienced eyelet and die maker; must have thorough knowledge and be able to lay out work; state full particulars, references and wages expected. Box 149, AM. M.

Wanted—Foreman of department in a large New England machine shop; must be a specialist in building machinery by modern methods; this department builds one type of machine only and the acceptable man must be competent to attain maximum results; shop equipment is first class and position permanent to right man; accepted applicant will be required to show his fitness by his past record and replies will be treated confidentially. State salary expected. Box 185, AMERICAN MACHINIST.

DELAWARE

Wanted—A-1 mechanic between 35 and 40 years of age, who has had wide experience in the manufacture of fire arms; must be a practical toolmaker and designer of jigs, fixtures and special machinery for the rapid and accurate production of interchangeable parts; must also possess executive ability and know how to handle help and material; in replying to this advertisement give age, experience and salary expected; otherwise no attention will be paid to the application. Box 210, AMERICAN MACHINIST.

ILLINOIS

Wanted—Screw machine and Jones & Lamson operators and toolmakers; good wages, no labor troubles. Velie Motor Vehicle Co., Moline, Ill.

Wanted—Several first-class lathe hands and fitters; we solicit applications from first-class men looking for permanent situations. The Ingersoll Milling Machine Co., Rockford, Ill.

Wanted—Foreman for blacksmith shop, manufacturing implements; must be sober and capable man and a hustler who can produce results with our present equipment; give references and state salary expected in first letter. Box 211, AMERICAN MACHINIST.

Superintendent for factory located in Chicago, manufacturing small specialties composed largely of sheet metal; must have experience with machinery and dies for drawing, stamping and forming sheet metal, and be capable of handling men and operating factory to turn out high-grade work at low cost; executive ability and good character are essential; give age, education, experience and other qualifications with references; also state salary required. Box 222, AM. MACH.

Wanted—Diemakers; high-grade men for small accurate work; toolmakers for gage, jig and fixture work; milling-machine operators for tool-room work; automatic screw-machine operators for Brown & Sharpe and other automatic screw machines; on this line of work we pay competent men 39 cents per hour; added premiums will make this rate average 42 cents per hour; hand screw-machine operators. In answer give full information. Address Department 1056, Western Electric Company, Chicago.

Wanted—A large agricultural implement factory, continually increasing its engineering force, solicits correspondence with technical men of proven ability, with view toward permanent employment; men familiar with up-to-date manufacturing methods and with several years' practical shop and office experience in the building of factory tools or special machinery, preferred; ample opportunity for advancement for man with initiative. In reply state age, exact experience, technical training, etc. Address Deere & Company, Moline, Ill.

INDIANA

Wanted—Foreman, one who has had experience in building machine tools; a bright future for the right man. Box 146, AM. MA.

Wanted—Machinists, we are continually increasing our force; we invite applications from lathe and floor hands, those who desire a steady position. Apply at Wood Turret Machine Co., Brazil, Ind.

Wanted—Traveling salesmen mechanically inclined, who visit shops and factories, to consider taking on a line consisting of a device already used in many of our best factories, and will not interfere with any other line. Box 177, AMERICAN MACHINIST.

MARYLAND

Wanted—Experienced designers on marine engines; give character of experience and salary desired. Address Ellicott Machine Company, Baltimore, Md.

MASSACHUSETTS

Sales manager wanted by progressive manufacturer building a line of special machine tools of extra high grade and employing 150 to 200 men; applicant must have had first-class experience in selling machinery and also in handling correspondence and the accompanying office work, advertising, etc.; please advise fully as to experience, age and salary expected. Box 209, AMERICAN MACHINIST.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—Twenty-five first-class experienced tool and automobile draftsmen; state age, experience, salary wanted, reference, etc. Buick Motor Co., Flint, Mich.

Wanted—First-class foreman for screw machine and turret lathe department, also two first-class men for setting up; state age, experience and reference. Buick Motor Co., Flint, Mich.

Wanted—Competent and experienced foreman for drawing room with 20 to 25 draftsmen; permanent position and good salary to right man; state experience, age, salary, references and full information. Box 204, AM. M.

Gasolene engine factory in southern Michigan requires more toolmakers, patternmakers and draftsmen on engine and tool and fixture work; applications from first-class men should state age, experience and wages required. Holms Machine Mfg. Co., Sparta, Mich.

MINNESOTA

Wanted—Several first-class salesmen to introduce and sell our patented speed shifter; will make liberal contract with A-1 men. Address F. L. Lucke, 1728 2nd St., North, Minneapolis, Minn.

MISSOURI

Foreman Wanted—An experienced man capable of taking charge of 100 men who thoroughly understands the manufacture of woodworking machinery. Address giving experience, nationality, age, reference and salary. Box 208, AMERICAN MACHINIST.

NEW JERSEY

Man to take charge of tool room; state experience and wages expected. Ferracute Machine Company, Bridgeton, New Jersey.

Wanted—Draftsmen familiar with machine tool work; give references and salary expected. Box 215, AMERICAN MACHINIST.

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Wanted — Electrical draftsman familiar with switchboard and controller work by manufacturing company near New York. Box 207, AMERICAN MACHINIST.

Wanted—Draftsman, must be a good mathematician and able to design small automatic machinery. Apply by letter stating age, experience and salary wanted. General Electric Co., Lamp Works, Harrison, N. J.

Wanted—Toolmakers conversant with fine subpress die work for small duplicate parts; only men of ability on this class of work need answer; factory located within 40 minutes of New York. Box 193, AMER. MACH.

Wanted—Machinists; steady work for good milling, boring, lathe and floor hands; also tool and die makers; call in person if possible; cheap rents and pleasant surroundings. Ferracute Machine Company, Bridgeton, N. J. (40 miles south of Philadelphia).

NEW YORK

Wanted—A thoroughly experienced operator for automatic screw machine. Box 223, AM. M.

Wanted—Expert toolmakers on punches and dies; good wages and superior shop. Apply Bates Machine Co., 704 Jamaica Ave., Brooklyn, N. Y.

Wanted—Toolmakers accustomed to very accurate watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Draftsmen and toolmakers wanted, experienced on tool, jig and fixture work; state age, experience in detail and rate expected. Remington Arms Company, Ilion, N. Y.

Gear cutting machine salesman wanted; smart, live salesman of good address wanted, with good connections in East; state age, experience, salary. "Push," AMER. MACHINIST.

Wanted—Experienced eyelet and die maker; must have thorough knowledge and be able to lay out work; state full particulars, references and wages expected. Box 148, AM. M.

Wanted—Lathe, planer, shaper and all-around floor hands; no labor trouble, good pay, steady work; state experience and wages wanted to start. W. B. Peirce, North Tonawanda, N. Y.

Wanted—Tool or diemakers accustomed to very close and accurate work; first-class men only; good wages; steady position. Apply by mail to Doehler Die Casting Co., Court & Ninth Streets, Brooklyn, N. Y.

Wanted—A young man as editorial assistant on a journal of mechanical engineering in New York; technical education and at least two years engineering or editorial experience. "Permanent," AMERICAN MACHINIST.

Wanted—Automobile manufacturer is in need of several first-class draftsmen; give account of experience, where employed, age, salary and earliest date you could report for work. Box 205, AMERICAN MACHINIST.

Wanted—Man to take charge of small tool and die department in large manufacturing establishment; must be thoroughly familiar with all branches; will also have charge of the up keep of finished stock and tempering; only the best of those so employed at present need apply. Box 127, AMERICAN MACHINIST.

Wanted—By large manufacturing concern in central New York, man familiar with steam and electrical power plants, millwright work, piping, etc.; also general plant up-keep; must be a good executive and able to lay out and supervise work in master mechanic's department when required; give experience, age and salary expected. Box 217, AM. MA.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable charcters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

OHIO

Wanted—One or two first-class diemakers to act as foremen; those having had experience in laying out work given preference; steady employment; good wages. Box 174, AMERICAN MACHINIST.

Wanted—A strictly high-grade factory manager for a successful and growing concern employing six hundred men manufacturing automobile parts; must have wide experience and exceptional executive ability; we want a strictly high class factory manager with a successful record as such; salary accordingly. Box 220, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

Wanted—A master mechanic with a good working knowledge of electricity in a manufacturing plant in West Virginia, to take charge under the superintendent, of the engine room, machine and carpenter shops, and look after all machinery; the factory is motor driven throughout with 850-horsepower plant; he should be able to handle the job from the start; factory employs about 125 men, 10 or 15 of whom will be under the master mechanic; we are willing to pay a good salary for a steady man about 28 to 35 years old; give details of experience and references. Address Lock Drawer L, Cleveland, Ohio.

MAKING the MARMON CAR

Fixtures Used in Boring Cylinders Facing and Reaming Valve Seats and Drilling and Boring Crank Cases

SPECIAL CORRESPONDENCE

It is interesting to note that the Marmon automobile, first built in 1901, but not really put on the market until 1905, is credited with being the first car built in this country to have side entrance to the tonneau, to have pressed-steel frame, now made only with water-cooled cylinders, as can be seen from the illustration.

Beginning with the cylinders, we have some very interesting fixtures, as shown in Fig. 1.

These photographs show an indexed fixture used for boring and facing cylinders. It is attached to the revolving table of a Beaman & Smith two-spindle boring mill. The fixture holds four pairs of cylinders, two pairs being bored while the other two pairs are being removed and replaced. The cylinder casting is placed in the fixture with the water opening in the top of cylinders slipped over two sliding blocks having lever-actuated cam in the center. The cam tightens the sliding blocks against the rim of the water opening. The hinged arm is then dropped and secured with a hinge bolt, as indicated. In locating holes a gage plate is placed over the bottom of the cylinders and the cylinder bores are adjusted to the gage by means of the four locating screws shown. One cylinder of each pair in position is

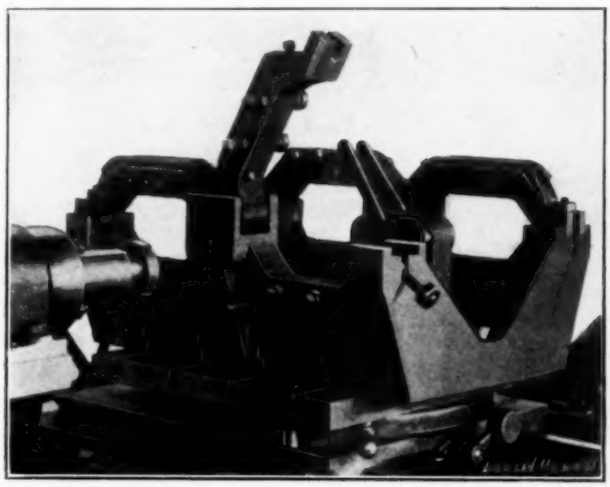


FIG. 1. CYLINDER-BORING FIXTURE

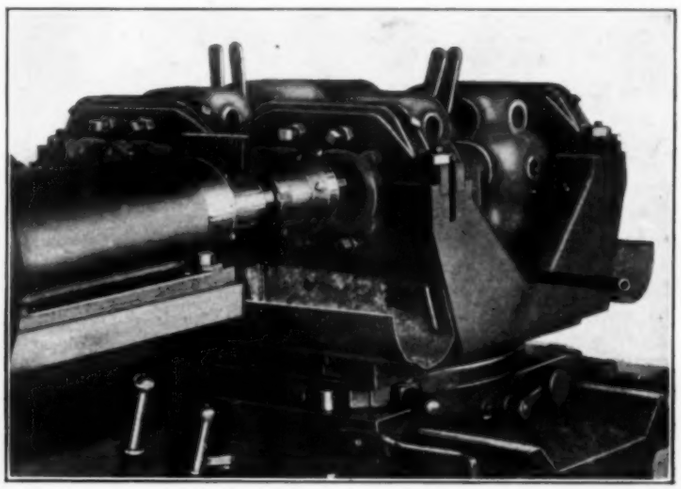


FIG. 2. CYLINDERS IN POSITION

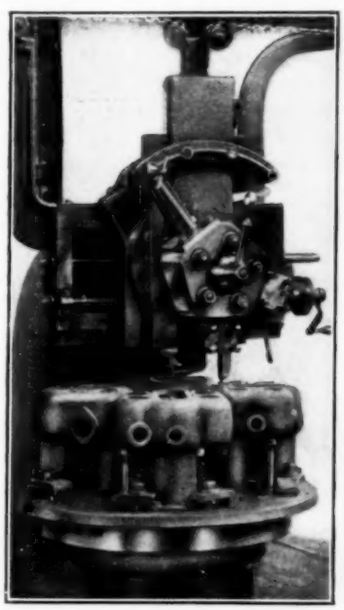


FIG. 3. FACING OFF CYLINDER TOPS

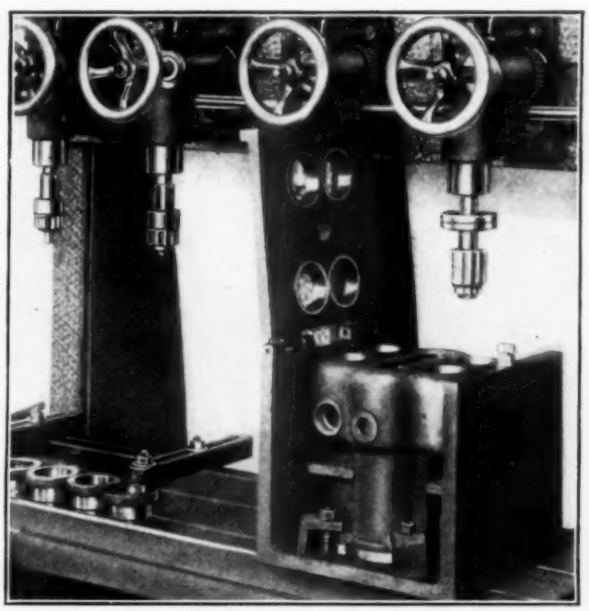


FIG. 4. BORING VALVE CHAMBERS

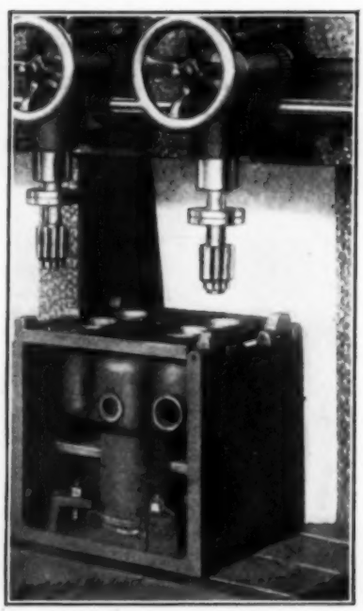


FIG. 5. BOX JIG FOR CYLINDERS

selective-type sliding-gear transmission, multiple-disk clutch with cork inserts and throttle and spark controls on steering wheel which did not turn with the wheel. At that time the car was equipped with four-cylinder air-cooled motor, which was continued until 1907, but is

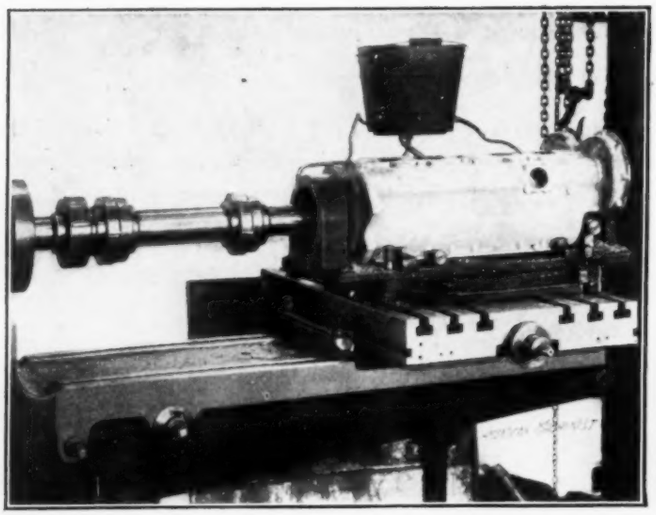


FIG. 6. BORING CRANK CASE

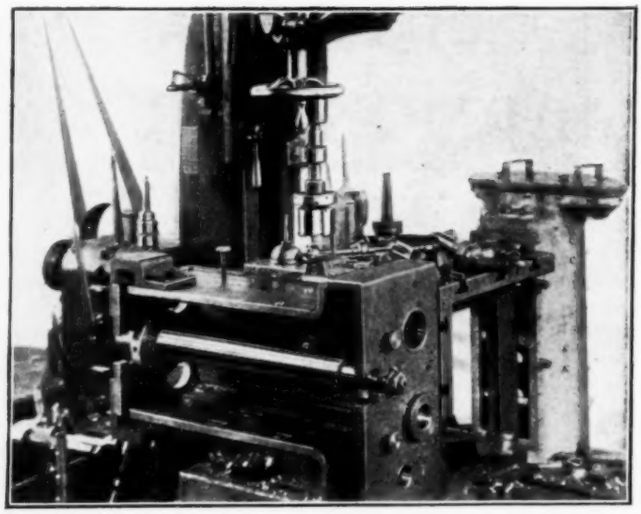


FIG. 7. DRILL JIG FOR CRANK CASE

rough-bored at one time. The table is then moved over against the stop, bringing the other two cylinders of the same two pairs in position for rough boring. The table is then revolved and the other four cylinders are rough-bored. By this time the first four cylinders are cool and are ready for finishing bore and facing. Three sets of boring tools are used which are of special construction.

These tools are shown in Fig. 2 and are constructed as follows: The butt end of the six cutter blades rest against a beveled screw plug in the center of the tool. Set screws hold the cutters. A jam nut holds the adjustment of the beveled screw plug. These are adjusted with key wrenches, the one for the screw plug being smallest and placed through the jam nut. By means of the bevel screw plug all six cutters can be adjusted simultaneously, ready for grinding.

FACING THE TOPS OF CYLINDERS

Fig. 3 shows a Bullard boring mill with a special face plate and locating pins and clamps, arranged for facing off the top of four pairs of cylinders at one time, as clearly illustrated. A hight gage locates the tool and the work is done rapidly and accurately.

In this photograph is also shown a special fixture on the turret, which is used when boring and turning piston-ring pots at the same time. An arm is attached to the turret face and a segment is attached to the vertical slide. Two double cutters are used, one for roughing and one for finishing. The arm is secured with a pin in the segment and brings the tool exactly to position every time, avoiding any effect of lost motion there may be in the turret head. In this way the piston ring pots are bored and turned at one operation.

In Figs. 4 and 5 are shown a box jig that is used for boring the valve-cover holes as well as boring and facing the valve seats. It is used on a six-spindle drill with three pairs of tools—one pair for rough cutting, one pair for second rough cutting and one pair for finishing. The construction of the jig and the bushings used are clearly shown.

Fig. 6 shows a fixture and boring bar used for boring the holes for the crankshaft bearings in a cast aluminum crank case. The crank case rests on the bottom of the fixture and against locating stops on one side. Two nurled-head screws, operating two wedges in the bottom of the fixture, are used to level the crank case and bring it in position for boring. The case is then clamped in place. The fixture carries at each end guides with hardened bushings for the boring bar. The boring bar has three

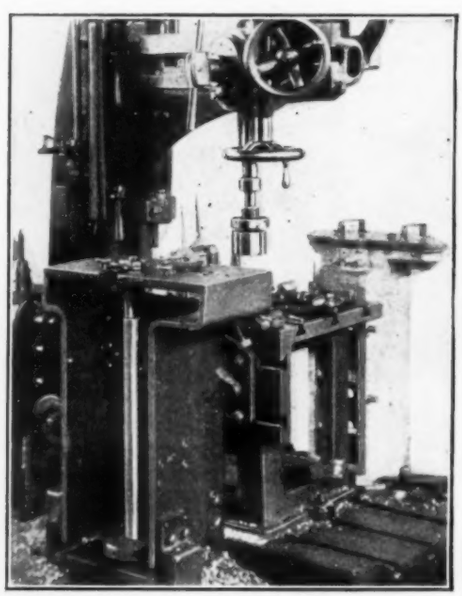


FIG. 8. ANOTHER POSITION OF DRILL JIG

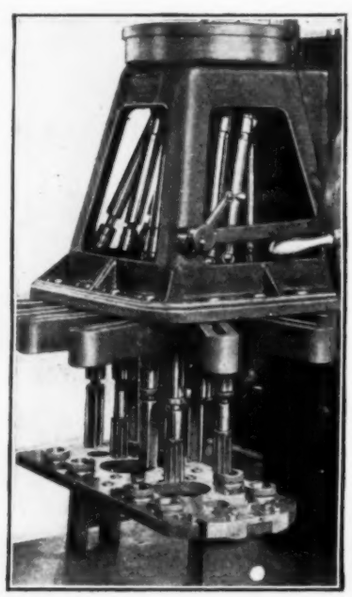


FIG. 9. JIG FOR MULTIPLE DRILL

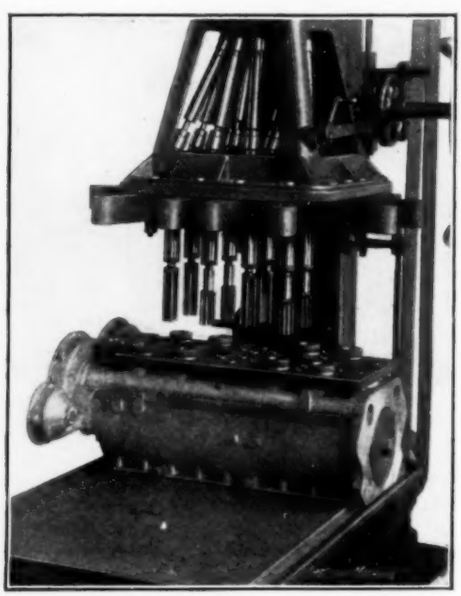


FIG. 10. REAMING HOLES IN CRANK CASE

pairs of cutters, each pair having roughing and finishing cutters. Thus the boring of the three holes for the bearings of the crank case is done with one operation, insuring uniformity and accuracy of alinement. A more practical arrangement has been provided for supplying water to the tool, since this photograph was taken.

Drilling Fixtures

An interesting indexed drilling fixture for the crank case is seen in Fig. 7. These photographs were taken without the crank case in place to show the method of holding the case in the fixture and the method of indexing. The arbor fits each end into the end bores of the crank case and is then slipped into the fixture, as shown in Fig. 8. Clamp blocks which are not shown in the photograph, fit into the supports at each end of the jig, holding the arbor home. The ends and top and bottom of the crank case are faced off before the crank case is put into this fixture. Wedges with screw adjustment are used against the top face for squaring the piece in the fixture. The fixture is pivoted to a plate which in turn is bolted to the radial drill press table, thus permitting the piece to be drilled on both ends and on both sides. All of the bushings are of tool steel hardened and ground as great accuracy is necessary. Nineteen holes, all told, the most important in the crank case, are drilled with this fixture. Beyond the table is a crank case with a small drill jig on the end.

Figs. 9 and 10 illustrate another fixture used for drilling the holes for valve-tappet guides, holes for cylinder bolts, etc., in the crank case. After the crank case has been bored, as shown in Fig. 6, all subsequent operations are located from these bores. The locating bar, one end of which is shown in Fig. 10, has two locating points turned in it on which the supports at the bottom of the legs of the drill fixture shown in Fig. 9 exactly fit, bringing the plate down on the finished surface of the crank case. It is then in position for the operation on the multiple drill, as illustrated. The use of the multiple-spindle drill in this way is not as common as it should be.

A boring fixture is shown in Fig. 11 for boring the bearing supports of the differential carrier plate. This fixture has two hinged arms which clamp over the piece. The base of the fixture is finished to receive the finished flange of the carrier plate and three dowel pins are used to locate the piece. In this fixture the pedestal or arms which carry the bearings of the differential are bored, and the boring must be exactly right angle with three gear centers in the plate. The fixture has hardened and ground bushings carefully located to bring the centers exact.

An interesting chucking fixture for holding an irregular shaped centrifugal pump case is shown in Fig. 12. This fixture consists of a cast-iron plate having four sets of double arms. The inner arms are notched to receive bolt-hole bosses of the pump body and the screws in the outer arms are set up, clamping the inner arms securely to the piece. The piece is held true when slipped home in the fixture. This is a novel method of making the inner projections act as jaws which are sprung into contact by the set screws in the outer piece. There is also an interesting facing tool at work on the piece.

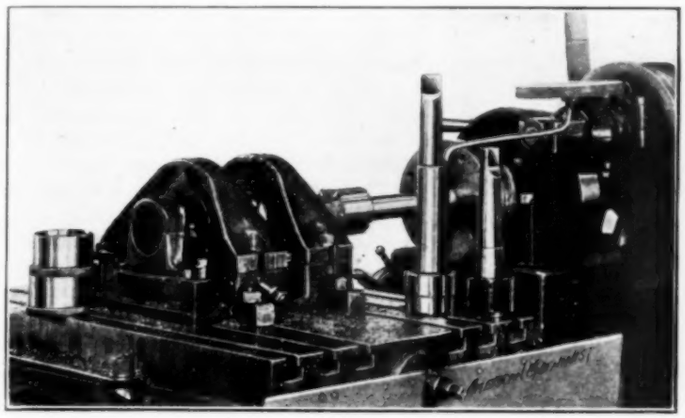


Fig. 11. Boring Differential Carrier Plate

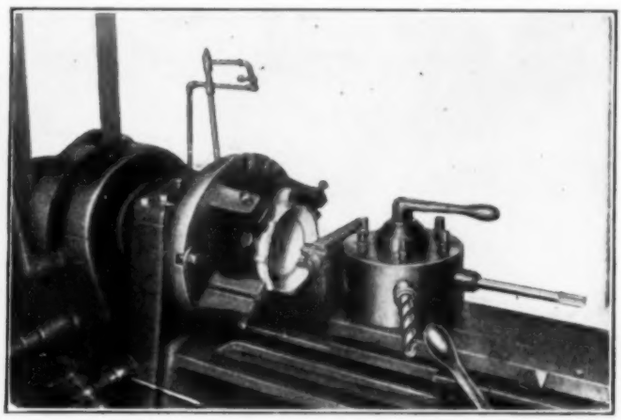


Fig. 12. Chucking Centrifugal Pumps

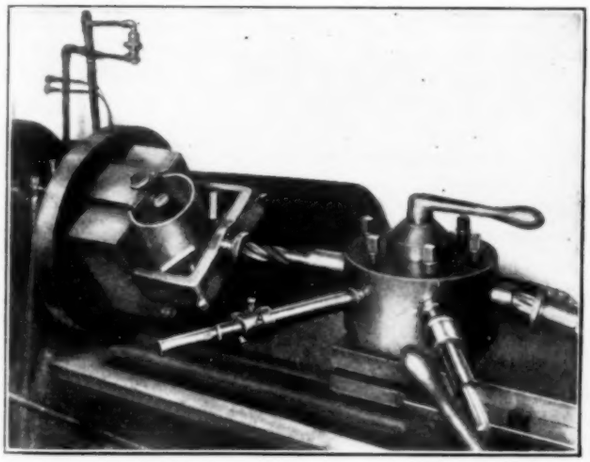


Fig. 13. Boring Wrist-pin Hole in Piston

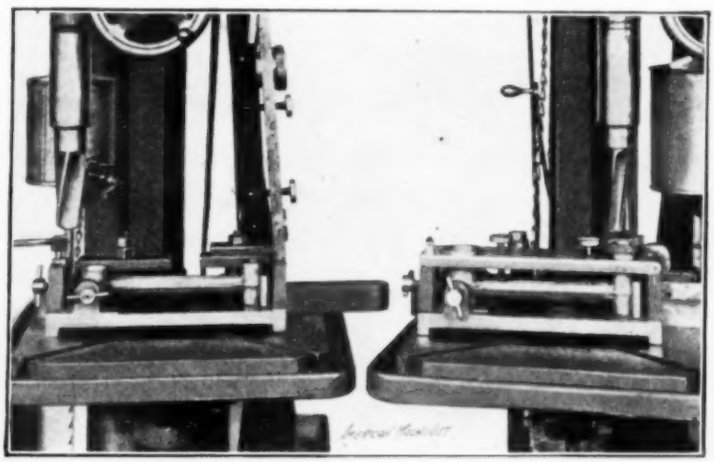


Fig. 14. Boring Connecting Rods

Boring Wrist Pin Holes

A special fixture for cross boring pistons for piston pins is shown in Fig. 13. This consists of a V-block with a forged yoke carrying the drill bushing and

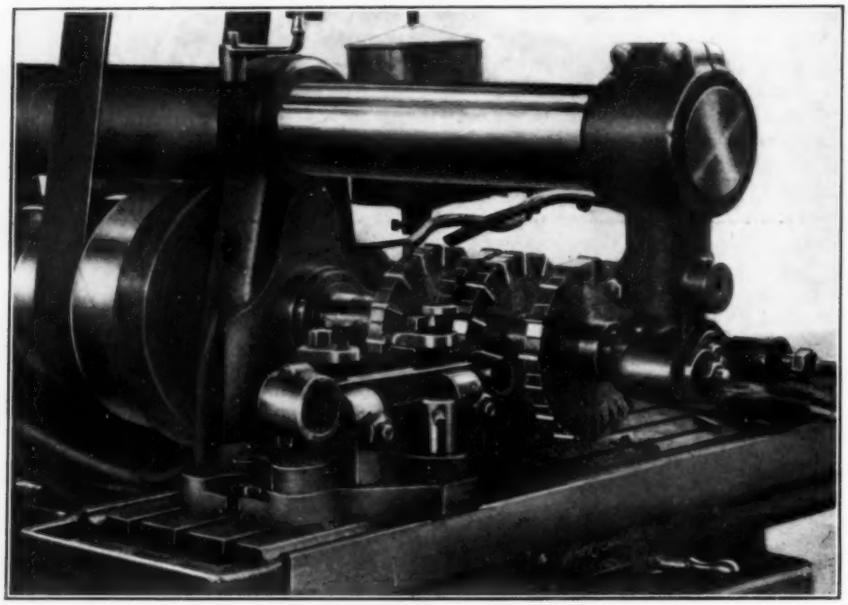


FIG. 15. MILLING THE CONNECTING RODS

hinged pieces, with set screws which bear against them and so hold the piston securely in the V. The piston is slipped in and rests on a locating bar which gives the center. A Y-shaped piece, with screw adjustment and a lock screw, slips inside the piston and fits over the bosses inside the piston, bringing the bosses in exact alinement for drilling and reaming. It is then clamped in place and is ready for the operations. One of the tools *A*, shown on the turret, is used for facing off the inside end of the bosses, being put inside the piston and the bar slipped through it, then fastened by a socket wrench on the set screw.

After the connecting rods are straddle milled they are taken to a six-spindle drill press, where they are put in hinged jigs as illustrated in Fig. 14. The first two spindles have first roughing cutters, both ends of the rod being drilled with one operation. The next two spindles have second roughing cutters and the third pair of spindles have finishing cutters, thus finishing one rod with one operation. Four of these jigs are employed so that while three are on the drill press the other is being prepared. The photograph shows this jig in use on a single-spindle drill, but it is regularly used on a six-spindle drill. The construction of these fixtures is interesting in several ways. The end of the rod is centered between the two steel pins at the right and held in place by screws which are easily and quickly handled. Ease of operation is one of the chief considerations in all their tools.

Fig. 15 shows a milling machine with four cutters arranged with an index fixture so that both sides of each end of the connecting rod may be milled without removing the piece from the machine. The milling-machine cutters are assembled on the arbor and spaced to suit the finish of each end of the rod, one end being 2 1/16 and the other 2¼ inches. The connecting rod is held in the fixture against two stop blocks on each end of the web of the connecting rod. It is then clamped by two clamps on the web at each end and also by two nurled-head screws on top. The rod is then in position to mill.

The operation is then as follows: First center one end of the rod with the cutters on the arbor. The fixture has indexed points which have the same center distance as the spacing of the cutters. Thus when one end of the rod is milled the other end is swung around with the fixture in position with the other two cutters. We are indebted to the Nordyke & Marmon Company, Indianapolis, Ind., for illustrations and information.

A Small Belt Sanding Machine

By C. Nosrac

This machine was designed for smoothing the four side surfaces of a wood strip, about 1 inch square and some 12 inches long, of which a large number were daily used. The general appearance of the machine is shown in Fig. 1. It will be noticed that the device is driven by a small electric motor, which makes it unnecessary to erect countershafting and pulleys, and enables the machine to be readily moved around, as may be found desirable. The frame is of cast iron and comprises a table-shaped top casting and a platform below, both being supported by suitable cast-iron legs.

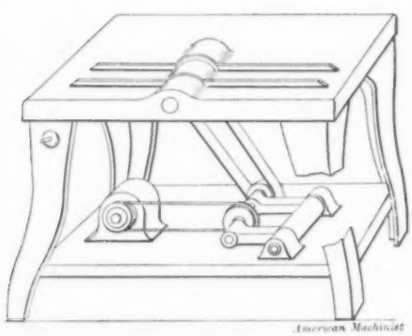


FIG. 1. SMALL BELT-SANDING MACHINE

Mounted in bronze bearings in the top of the frame is the shaft carrying the sandpaper belt pulley, which is fastened to the shaft and is about ⅜ inch wider between its flanges than the width of the sandpaper belt, in order that the belt may have a chance to oscillate back and forth along the pulley and bring all portions of its cutting surface against the wood. Two strips on the top of the machine serve to guide the wood piece, while being pushed across the belt.

The driving motor is below, carrying on its armature shaft two V-pulleys for ⅜-inch round belts, one pulley being slightly smaller in diameter than the other, in order to give a difference in speed of about 50 to 60 revolutions per minute between the two driven pulleys on the swinging bearing arm, at the other end of the platform. This swinging arm is of cast iron and mounted on a steel shaft between two bosses on the platform, and has a bronze bearing in each of the outer extremities, in which the oscillating belt-pulley shaft and sleeve

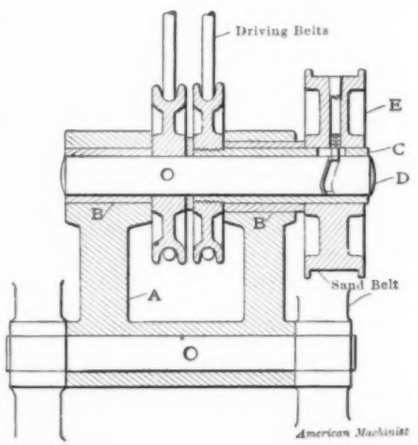


FIG. 2. THE OSCILLATING DEVICE

run, and a helical spring attached to the outer lower side of this arm and to the platform below serve to give the desired tension to the sandpaper belt.

This arm is shown in sectional detail in Fig. 2, in which *A* represents the swinging arm, *B* the bronze bearing bushing, *C* a hardened and ground steel sleeve, to the inner end of which is fastened one of the driven V-pulleys and having at its outer end a short, elongated slot, about ⅜ inch wide and 1 inch long. Within the sleeve runs the hardened and ground shaft *D* to the center portion of which is fastened the other driven V-pulley, and having a cam pathway with a throw of about ⅛ inch around its outer end. The sandpaper driving pulley *E* runs loose on the outer end of the sleeve *C* and carries a hardened steel pin, which passes through the slot in the sleeve and enters the cam groove in the shaft *D*.

It will be seen that at whatever speed the motor may be run, there will always be a difference in the number of revolutions between the sleeve *C* and the shaft *D*, which will cause the sanding-belt pulley to oscillate back and forth in the sleeve, and bring all portions of the belt in position to do their share of the cutting. This machine has proven very efficient and does its work rapidly and well. The motor is controlled by a snap switch, conveniently mounted on the machine, and connection is made from a nearby lamp socket with a flexible cable.

Reconstructing Lathe Bed Patterns *By O. E. Perrigo*

The absolute failure of a pattern or an entire class of patterns is not always a sufficient reason for throwing them aside and incurring the expense of a line of new patterns designed and constructed upon newer and better systems. Before proceeding to such radical measures we should first carefully examine the design, construction and other similar conditions and consider whether these expensive patterns may not be saved and utilized in carrying out betterment plans. The following plan will illustrate the theory advanced.

In a large shop manufacturing machine tools there had been much complaint at the excessive cost of repairs and maintenance of the patterns for casting lathe beds. An examination of the patterns disclosed the following conditions.

The castings required were of the form given in cross-section in Fig. 1, which shows the older form of bed with cross ties or braces of a single plate ribbed at the bottom edge, as shown at *A*. The pattern for the track or ways was made in a separate piece fitting loosely as shown. The pattern was so made as to "leave its own cores," the corners being well dovetailed together and the crossbars mortised into the side members of the pattern.

From the fact that the side and end members of, say a 21-inch lathe bed pattern, were only about 11/16 inch thick, and the patterns made of white pine, it will be seen that these joints, however well made, would not stand the ordinary rough usage of molding for any great length of time, but would become weakened, then broken, and the rigidity and accuracy of the pattern destroyed. In addition to this the side members would become more or less warped and hence very difficult to draw out of the sand without more or less injury to the mold and consequent defacement of the castings.

The method adopted for avoiding these difficulties was the reconstruction of the pattern and the necessary changes in the methods of molding as will be described.

It was first decided that to make the pattern strong enough to stand the regular work of molding it must be of box form with a proper print for locating cores which should form the inside surfaces of the casting. The bed pattern was first greatly strengthened by rectangular frames as shown at *D*, Fig. 2, placed from 12 to 16 inches apart according to the thickness of the side members of the bed patterns. These frames were made of the proper hight to permit the addition of a top board *E* and a bottom board *F* to be set up in flush with the pattern, thus forming a tight box. Upon the top of the board *E* was fixed the core print *G*, running the entire length of the opening in the top of the bed.

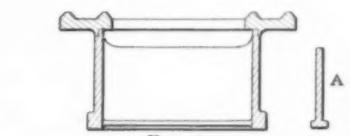


FIG. 1

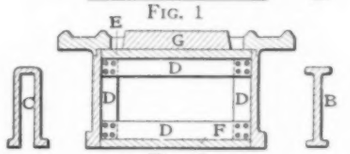


FIG. 2

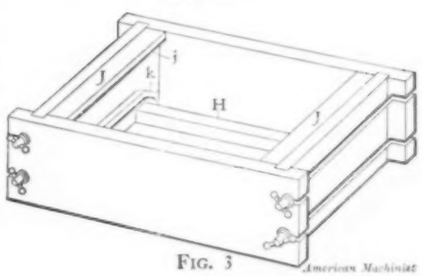


FIG. 3

RECONSTRUCTING LATHE-BED PATTERNS

Fig. 3 shows the core box designed for this work. The sides were grooved to receive the end pieces and the whole held together by threaded rods provided with hand nuts, and placed in slots, as shown so as to be readily removed when the box is to be taken apart. The ribs *H* were set at the same distance apart as the width of the core print *G*. The end pieces *J J* are set in loose. Their inner surfaces are provided with ribs *j k*, for forming the ribs on the cross ties or braces of the casting, giving them the cross-section shown at *B*, Fig. 2.

The bed pattern is molded bottom side up, the track or ways being "bedded in," after which the main part of the pattern is laid on and the "cheek flask" rammed up. The cope is then put on, rammed up and lifted off. The main part of the pattern is drawn, the cheek flask lifted off and the track pattern drawn. After the mold is made ready the cheek flask is returned to its place and the mold is ready for the cores.

The cores are made of green sand, the core box shown in Fig. 3 being placed upon the usual bottom board and a cast-iron bottom plate having one or two lifting rods, according to its size, introduced. The loose end pieces *J J* are placed as shown when full length cores are wanted. In making various lengths of beds these cores will vary from 2 to 6 inches in length. This is provided for by loose pieces placed between the core box end and the loose piece *J*. The core is rammed up of green sand and the core box removed by taking it apart. The core is slicked up, lifted by the crane and set in place at one end of the mold, leaving sufficient space for the thickness of metal at the end of the casting. The next core is made in a similar manner and set closely against the first one, the loose end piece of the core box being so formed as to provide for the thickness of metal for the cross tie.

When cross ties of the box form, as shown at *C*, Fig. 2, are wanted the green sand cores are set at such distances apart as to provide for the entire thickness of the cross tie, the inner space of which is formed by a dry sand core supported and held in place by chaplets.

This method of reconstructing the old bed patterns proved entirely satisfactory in practice. All the former bed patterns were utilized by a moderate outlay for pattern work; much higher grade castings were produced and the former risk of defective castings was very much reduced. The patterns for all later designed beds were made by similar methods.

EDUCATION of APPRENTICES in BRIDGEPORT, CONN.

Co-operation of Y.M.C.A. and Makers

EDITORIAL CORRESPONDENCE

The question of industrial education has been rife in Bridgeport, Conn., as elsewhere, and has been handled in a little different way than in other places. The question began to be agitated in the early spring of 1908, and in the fall M. W. Alexander gave a talk before the Manufacturers' Association, on the General Electric Company's shop schools at West Lynn, Mass. Later a very complete delegation of Bridgeport, manufacturers visited Mr. Alexander's school and while impressed with its practical value, did not see their way clear toward following its example in their own shops.

So the industrial secretary of the Bridgeport Young Men's Christian Association, Jeremiah Holmes, submitted a proposition for a joint school to which one or more apprentices could be sent from a number of factories. This proved a very satisfactory solution of the problem and in November, 1908, the school opened with 47 young men from 16 different shops. These were mostly, though not entirely, apprentices, 24 being in the machinist trade, 16 toolmakers, 6 patternmaking and 1 in electrical engineering. John A. Brodhead, a graduate of Lehigh, was selected as the instructor.

The boys come for two hours, three times each week and are paid for their time. The classes are arranged from 10 to 12, 1 to 3 and from 4 to 6 so as to bring one trip on the boy's own time and the other on that of the employer. Each boy has two hours of instruction three times each week for 30 weeks, making 180 hours of class work divided into 90 lessons per year.

The charge for instruction made by the association is $20 per boy and it is estimated that the wages paid during instruction and the loss in production bring this up to approximately $60 per boy as the total cost to each manufacturer, which is remarkably low.

The Studies and Books Used

An outline of the work covered by the apprentices during the first year's instruction is as follows, although this is sometimes modified according to the judgment of the instructor.

SECTION A.

Subject.	Time Spent Upon Each. Weeks.
"Wentworth's Algebra"	8
"Geometry Book I." Study of angles and plain figures	8
Colvin's "Machine Shop Calculations"	10
Drawing with calculations	4

SECTION B.

	Weeks.
"Wentworth's Practical Arithmetic"	7
Colvin's "Machine Shop Calculations"	11
Elementary drawing and sketching	9
Drawing with calculations	3

SECTION C.

	Weeks.
"Wentworth's Practical Arithmetic"	8
Milne's "Elementary Algebra"	9
Elementary drawing and sketching	11
Drawing with calculations	3

SECTION D.

	Weeks.
"Wentworth's Practical Arithmetic"	10
Elementary drawing and sketching	18
Drawing with calculations	2

All parts of "Wentworth's Arithmetic" having no shop application were omitted. The prime object of the algebra was to teach the use of formulas as found in shop handbooks. Elementary drawing and sketching were very largely for machine parts. Drawing with calculations included laying out of simple drill jigs by use of trigonometry tables (from Colvin's "Machine Shop Calculations"), accurate spacing of bolt holes, etc., making use of formulas whenever possible.

There are also evening talks and shop visits in order to add to the boy's general knowledge of fuel, power, raw materials, and the mechanical processes of the industry of his choice. It is also the aim of the school to increase the punctuality, ambition and efficiency of the boys, and the interest has been maintained remarkably well.

In addition to the books indicated in the course and supplanting some of these, they are now using sections of the "Questions and Answers from the AMERICAN MACHINIST" for general information.

The AMERICAN MACHINISTS' handbook is also being used as a textbook, taking such sections as are needed by these boys and also with the idea of showing how to find and apply any information they may need in connection with the practical work of the shop. This is an excellent plan in every way, being much better than attempting to memorize a lot of rules and formulas.

It is also the intention a little later, to include a good mechanical publication in the course of studies to show how it can be used to the best advantage. Articles will be assigned to different boys to see how much information can be had from them.

The New Bridgeport Trade School

The State of Connecticut is also waking up to the industrial situation, and at the last legislature passed a bill authorizing the establishment of two schools in the State. One of these is to be in Bridgeport and the other in New Britain. Bridgeport has already secured its building, and is to be equipped with about $15,000 worth of machinery and tools suitable for the training of machinists, toolmakers, carpenters and plumbers.

This school will take boys 14 years old or over, and while the plan of work has not been definitely decided upon, they are considering the making of commercial work from the local shops as a means of getting away from exercise work, of keeping the boys interested, and of helping to defray the cost of instruction. This plan seems to have much in its favor after the details are carefully worked out.

They are also considering the plan of alternating boys between the trade school and the local shops, after the Schneider and Fitchburg plans, and to have general supervision of the boys so employed in order that they may receive the best shop training instead of being considered solely from the point of view of production. Whether this will eventually supersede the present trade school at the Y. M. C. A. remains to be seen, but there is every indication that it will.

Nearly all the manufacturers are satisfied with the results obtained by their boys and have returned them the second year. A few have dropped out for various reasons and with different excuses. All seem to think the boys were better for the training and would make better workmen. There has been no apparent difference in the number of applications, but this had not been such a vital question as in some localities.

Special Apprentices

While not directly connected with the educational plan, the question of training boys or men in Bridgeport would hardly be complete without a mention of the special apprenticeship courses which have been in use by the Bullard Machine Tool Company for several years. These courses take bright young men, often from the laboring force, and train them to run one class of machine well. A grinder for example is trained on surface, cylindrical, internal and universal grinders so that he can handle any grinding work that comes along. This plan has been extremely satisfactory in every way and is being used by several large shops at the present time. There has never been any difficulty in securing the desired number of men under this method.

Jackets, Inter- and Aftercoolers

By S. B. Redfield

In the compression of air, there are three places where the process of cooling enters. As is well known, the compression heats the air, in fact all the work of compression is transformed into heat.

If the compressed air could be used directly while it is still hot, most of this heat could be transformed back into work again, resulting in greatly increased economy. However, in most cases, by the time the compressed air has reached the machine which it is to operate, it has radiated its heat into the atmosphere and returned to about its original temperature.

As all the heat of compression is thus lost anyway it is possible to increase the economy to some extent (about 12 per cent.) by deliberately removing this heat at a definite and most advantageous time, during compression. Most persons are aware of the fact that compressors for pressures exceeding 10 pounds are provided with water jackets around the cylinders. In some cases, as for air-brake work, the effect is produced by external cooling webs cast on the cylinders whose rapid motion of transportation through the atmosphere has a cooling effect.

Real Use of the Water Jacket

There is an erroneous idea as to the use of a water jacket on a compressing cylinder, that is, that cooling of the air is thus accomplished and thus the compressor is called upon to do less work. Now, a moment's thought will show that the cold walls of a cylinder can come into contact with but little of the air contained, and as air is a poor conductor of heat, there is little chance for the air in the center of the cylinder, especially if of large diameter, to be cooled in this way. Moreover, as the piston is compressing the air and making it hotter, it is also sweeping along so as to cover up the cool wall surface, thus reducing the cooling area as it advances. As a matter of fact, the jacketing of the cylinder heads is the only part which is really effective in cooling the air.

If then, water jackets are inefficient, why are they used? Primarily, to preserve the lubricating oil on the cylinder walls. With single-stage compression of air to 100-pound gage pressure, at sea level, the temperature reached within the cylinder is nearly 485 degrees Fahrenheit. At an altitude this may easily be exceeded, because the atmospheric pressure being less, a given gage pressure means a greater ratio of compression. Such high temperatures have a carbonizing effect on the cylinder oil, causing a black sooty deposit, which when thick has even caused explosions of the gases formed in the cylinder. The cool jacketing assists in preventing this decomposition upon the walls. There is also, of course, a slight cooling of the air by the cylinder jackets, especially the heads, and this does assist a little in cutting down the power required to compress, which is shown by the fact that the compression curve of the indicator diagram is slightly below the adiabatic curve.

Intercooling, the Reason for Compounding

After the water jackets, the next cooling process takes place in the intercooler, between the stages of compression of a compound compressor. Here, in a properly designed intercooler, the heat caused by the compression in the first, or low-pressure cylinder, is largely removed from the air by passing it over tubes through which cooling water is circulated. It is here that real economies can be attained, with suitable construction, for the removal of the heat reduces the volume of the air before it enters the high-pressure cylinder, resulting in less work to be done in this second stage of the compression.

Opportunity to cool the air is the only valid excuse for compounding an air compressor and unless this is done the machine would better have been constructed with but one stage, thus removing the throttling losses in passing the air through the intermediate passage, the inlet and outlet valves of the second cylinder. Some cheap air compressors have been put upon the market, with "compound" cylinders, with little or no means for cooling between stages and by this, defeating the purpose of the compound construction.

Where the Water Comes from

Jackets and intercoolers are the usual cooling devices used in an air-compressing installation but sometimes an aftercooler is seen. At first thought, such a contrivance seems an absurdity, for it may be asked; why take out the heat at this point when the compressing process is all over, and any residual heat that might possibly remain would result in some slight economy at the user's end?

In the first place it is seldom a fact that any heat will remain by the time the air is used and if the air is cooled immediately after compression a great economy in the saving of trouble is actually attained. This trouble comes from the presence of water in the air which, in damp weather may actually prevent operation by clogging the ports of the tools driven and if the weather is at all cool, in the formation of ice in the ports, from the cooling effect of expansion. This freezing is so persistent that in many cases, reheaters are used, these sometimes taking the crude form of a bonfire under the air pipe.

Where does this excess of water come from? What happens is this. All atmospheric air contains moisture in the form of invisible vapor; sometimes more, sometimes less. This moisture is ordinarily held in suspension, or mixture with the air, because the conditions of saturation and temperature keep it in the vapor state. Now, when, with a given "degree of saturation," as the percentage of moisture in the air is called, the weather becomes colder, what is known as the "dew point" is reached. This dew point is that temperature at which, with a given degree of saturation, the air will deposit its vapor in the shape of dew, rain, snow, etc.

The Aftercooler. Artificial Rain

To apply this to an air compressor; when the atmospheric air is compressed the tendency is to squeeze out the moisture, but owing to the fact that the air is also greatly heated, as it is compressed, the dew point is not reached and the vapor continues in suspension, passing out of the cylinders and into the pipe line. When, however, this air has become cooled by radiation, as it travels along, the dew point is finally reached, the pressure squeezes out the moisture and it literally "rains" inside the pipe line. This rain deposits upon the cooler walls of the pipe, runs down into the bottom and flows with the air into the drills, hammers, hoists, etc., which are being driven, giving rise to the clogging and freezing mentioned. This may occur even when the weather does not seem to be excessively damp.

Some attempt to remedy this condition is made by putting drainage tanks and traps in the pipe line to catch the water and in most cases this is sufficient. There is, however, a very efficient remedy which will be successful even when all the efforts at draining fail. This is by the use of an aftercooler, which, placed to receive the hot air immediately after compression, cools it at once to the dew point, thus forcing it to deposit its moisture where suitable drainage may be arranged and allowing only the dry air to travel the pipe lines and operate the machines with no trouble from clogging or freezing, even in cold weather.

Aftercoolers are usually of the same design as intercoolers, and with a compound compressor, should contain at least as much cooling surface. This is for the reason that the work done, and consequently the heat generated, in the two stages of a compound compressor is the

same, so there is the same amount of heat to be extracted by the aftercooler, after compression in the high-pressure cylinder, as there is by the intercooler after the first stage of compression in the low-pressure. The following figures represent good practice in proportioning both aftercooler and intercooler surface for compression to 100 pounds at sea level.

Temperature cooling water, degrees Fahrenheit 60, 70, 80 and 90. Cubic feet free air per minute per square foot cooling surface 8, 7, 6 and 5.

For altitude work; that is, compression in the mountains, it will be about right to proportion the cooling surface on the basis of taking care of the same horsepower developed, as equal horsepowers mean equal heat quantities, although not necessarily equal temperatures.

For aftercoolers only, that is with single-stage compression more surface must be provided because none of the heat has been removed by an intercooler, and of course, the horsepower is also greater. The following figures represent good practice for aftercoolers only, with single-stage compression to 100 pounds at sea level.

Temperature cooling water, degrees Fahrenheit 60, 70, 80 and 90. Cubic feet free air per minute per square foot cooling surface 5½, 4⅔, 4 and 3½.

The same remarks as to altitude apply to single-stage work as to compound. It is, however, advisable to use a compound machine for altitude work when 100-pound pressure is wanted, because of the higher temperatures reached.

In designing inter- and after-coolers it is better to lean toward liberality of surface, even beyond the figures given, because this means economy of water as well as of power and the tendency in the past has been rather to skimp on cooler surface, to the detriment of the results striven for. It is a good idea not to go beyond a ratio of 7 to 1 with intercoolers, except for small cheap machines. Also, both coolers should provide ample means for draining out the deposited moisture, because in compound compression condensation takes place in each.

Indirect Shop Heating System

The indirect shop-heating system of the main building of the Brown Hoisting Machinery Company, of Cleveland, Ohio, is of interest from the manner in which all parts of the apparatus, engines, fans, heaters and conduits, have been kept out of the way so as not to interfere with space or work in the shop. Again, the entire system is contained within the shell of the building, so that the heating of non-used space is at a minimum.

Fig. 1 shows a floor plan of the building, with location of main columns, four heater pits and hot-air conduits. These pits and conduits are beneath the shop floor.

Fig. 2 shows a heater pit in plan and section, and the cold-air intake. The pit is circular in shape, built with concrete walls. The bottom below the fan is shaped to the fan scroll. A duct at the back connects with a louvre opening to the outside air for a fresh-air intake, or to a screened opening to the shop. A hinged damper can close either opening at will.

The pit is roofed with steel plates on a

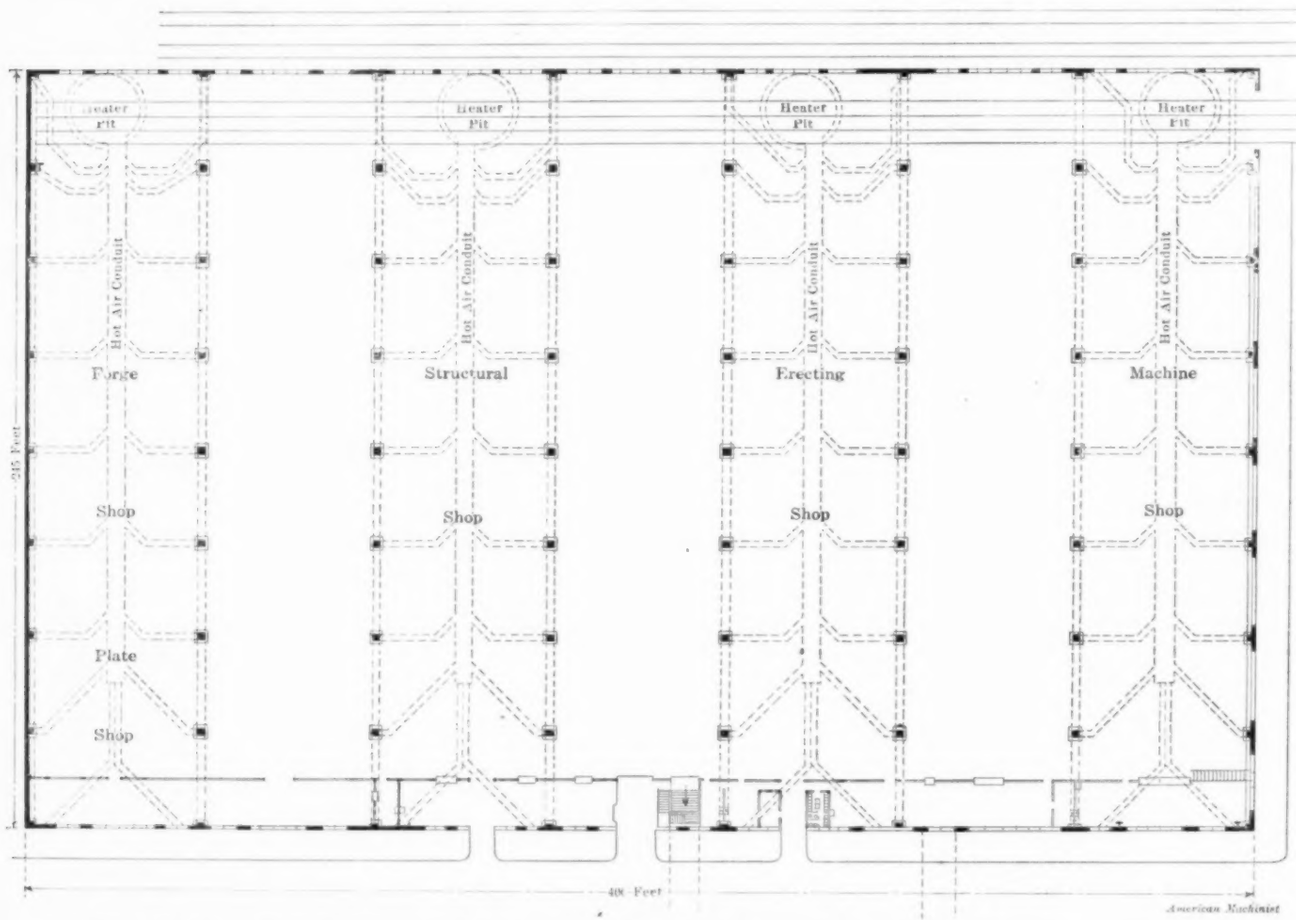


FIG. 1. PLAN OF MAIN BUILDING OF BROWN HOISTING MACHINERY COMPANY, SHOWING SHOP-HEATING SYSTEM

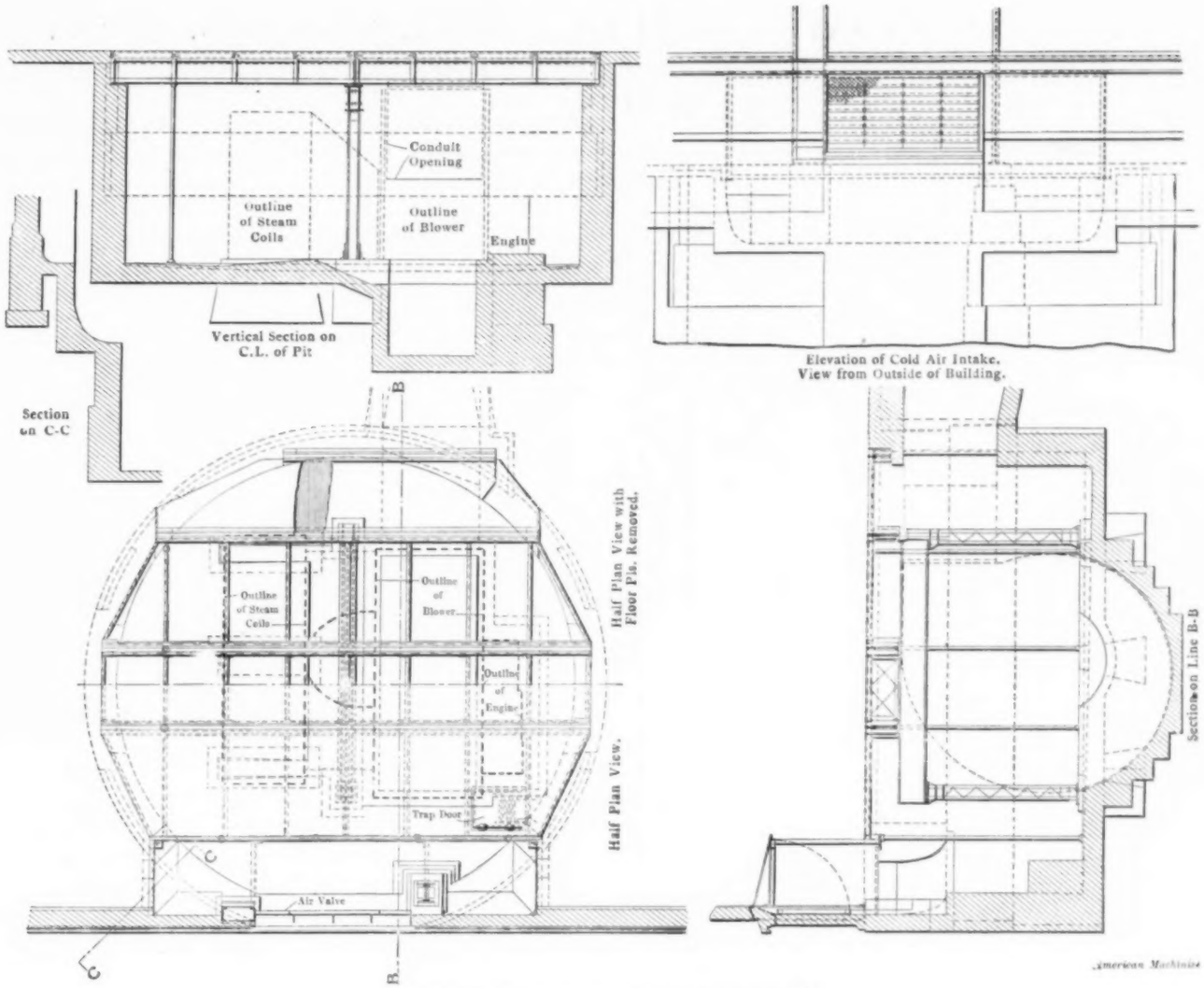


FIG. 2. PLAN AND SECTION OF HEATER PIT

steel framing, so arranged that they can be removed if necessary.

The fans have a top horizontal discharge, entering a concrete duct, horseshoe shaped, running directly across the building and decreasing in size as branches are taken off. This decrease is accomplished by decreasing the depth of the duct below the insert, and keeping the insert unchanged. The advantage of this, as regards making concrete forms will be appreciated.

The branches are 24-inch tile sewer pipe running from the main conduit to each column in the building. Here connection is made through a hole 22 inches in diameter to the interior of the latticed columns.

The opening from the columns to the shop is shown in Fig. 3. Two deflectors are used, sending out the air in two streams on opposite sides of the columns and at a hight of about 3 feet above the floor.

Thus it will be seen that the system is entirely away from all working space—most of it is under the floor. The conduits and pipes under the floor keep the floor warm and the heated air enters the room very close to the floor. The air intakes are so arranged that the supply can be drawn either from the outside or from within the ship. The subdivision of the system into four units carries with it the usual features of flexibility and safety from accidental crippling of the entire system.

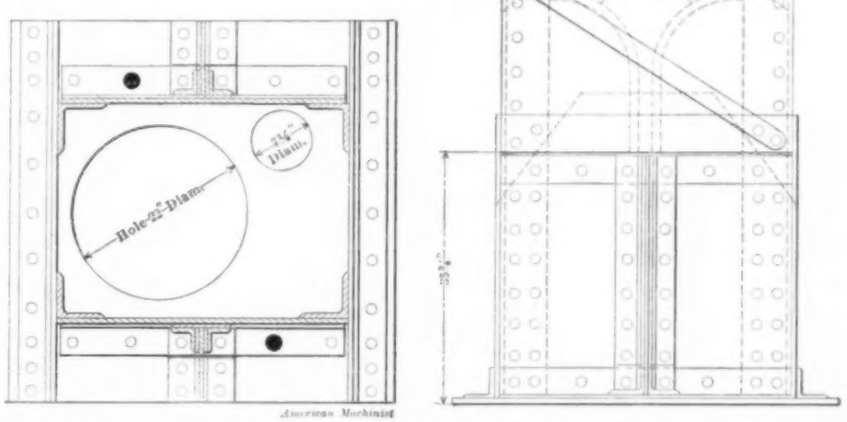


FIG. 3. PLAN AND PART ELEVATION OF COLUMN SHOWING HOT-AIR OPENINGS AND DEFLECTORS

The NARROW GUIDE in MACHINE TOOLS

Its Application to the Design of Sliding Bearings of Various Kinds to Prevent Cramping

BY FRED HORNER

During the last four or five years a change has been taking place in the methods of fitting certain machine slides, a change to which very little attention seems to have been drawn. I refer to the narrow guide, by means of which a great preponderance of length to width of bearing is secured, with many advantages as a result.

Application to Lathe Bed and Saddle

The first application of this principle appears to have been that by John Lang & Sons, about 1900,* when the firm fitted a narrow raised strip at the front edge of their lathe beds, this strip acting as a guide to the saddle, there being no contact at the rear edge of the bed. Fig. 1 shows the fitting of saddle and bed, as made at present, the raised portion being abolished in favor of a flush top, though the narrow strip is still present. The advantages to be gained from this construction are numerous. Having such a great length of bearing on a narrow width, the twist of the saddle when traveling is much lessened, because it does not tend to slew round and hitch on the extreme corners, as a saddle bearing right across the shears will tend to do. Less power is, therefore, required for feeding, and the strain on change wheels or feed gears is lessened. The guiding surface is also nearer to the lead screw, an obvious advantage. It has been found after years

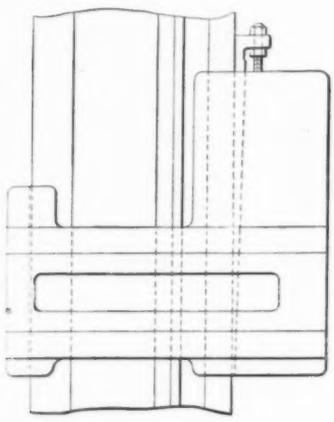


Fig. 1

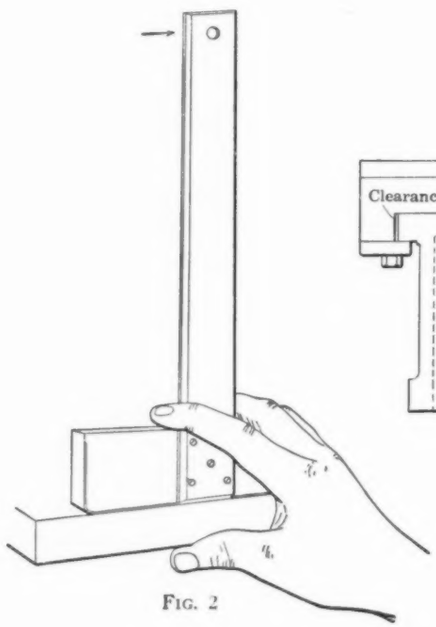


Fig. 2

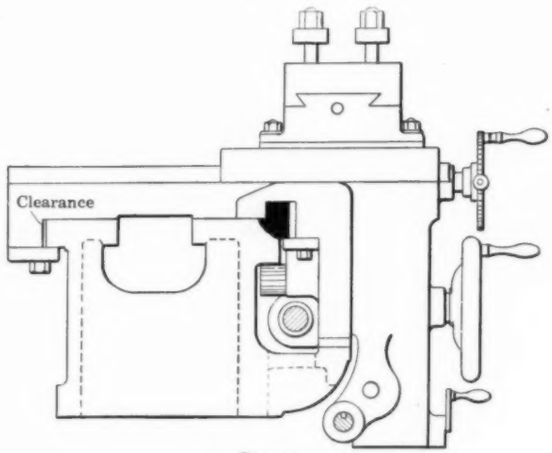


Fig. 3

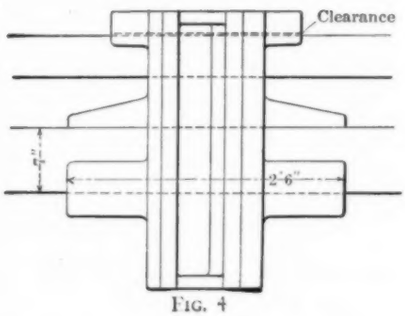


Fig. 4

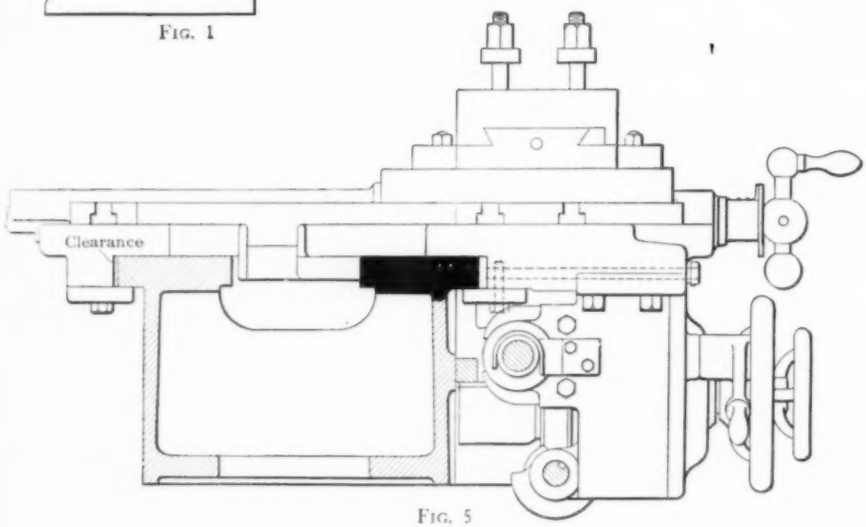


Fig. 5

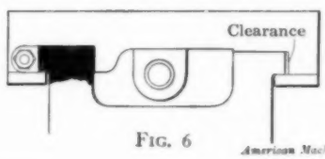


Fig. 6

American Machinist

The Narrow-guide Principle in Machine-tool Construction

*Professor Sweet's use of this principle goes back to the '70s to our knowledge and very likely earlier. It is one of the many seed which, sown by him thirty years ago, are now beginning to sprout.—Ed.

of use that the saddle will remain true in relation to the headstock so that facing can be done square across at all times. Another point is that the setting up being done along a width of solid metal, there is no tendency to spring the shears together.

Action of the Narrow Guide

The action of the narrow guide is analogous to that of a long shaft fitting in a small hole, while the ordinary type of slide may be compared to a large shaft fitting in a short hole, a difference which may be easily understood. But I know of no simpler way of demonstrating the idea than that of taking a T-square, and clamping it with the hand, as shown in Fig. 2. The distance between the working face of the head and the face which rests on the drawing board represents the narrow guide, and the blade represents the remainder of the saddle. Now if attempt is made to push over the blade at its extremity, as indicated by the arrow, a very great resistance will be felt, whereas if you try to hold the T-square steady by pressing on the top end of the blade only, you will find that it can be easily tipped over.

Other Applications to Lathes

The narrow guide is employed by various other lathe manufacturers, either as a raised strip, or by using the front shear of the bed only for the guide. In the Darling & Sellers lathes the strip is raised, and a double-tier arrangement is fitted to take the weight of the overhanging apron, Fig. 3. The narrow guide here is shown in black, as it is similarly in the other drawings, to bring out this feature clearly. In a special two-saddle lathe by Pollock & Macnab, Ltd., the raised strip and lower tier are utilized to support the saddles on their own respective front and back shears, so that they may pass each other.

When the front shear is used as a narrow guide, some amount of extra bearing length is sacrificed (as compared with the strip), but there is still a considerable advantage to be gained. Fig. 4 gives a plan view of such a saddle, in which the ratio of length to width of guide is over 4 to 1. An arrangement of a saddle and bed of this class is illustrated in Fig. 5, as used by John Stirk & Sons, Ltd. The take-up strip or gib is placed against the edge of the front shear, and a strip underneath prevents lifting, there being another strip under the lip of the back shear for the same purpose.

It is evident that the narrow guide may be applied also to the slides of rests, and Messrs. Lang in fact adopt this method of fitting for the rests of some of their surfacing and boring lathes. Fig. 6 shows such a fitting, with a tapered gib on the outside edge. The operating screw may sometimes set closer to the guide to lessen the tendency to cross-working.

Uses on Planer, Boring Mill, Profiler and Miller

Another application of a somewhat similar kind is that represented in Fig. 7,

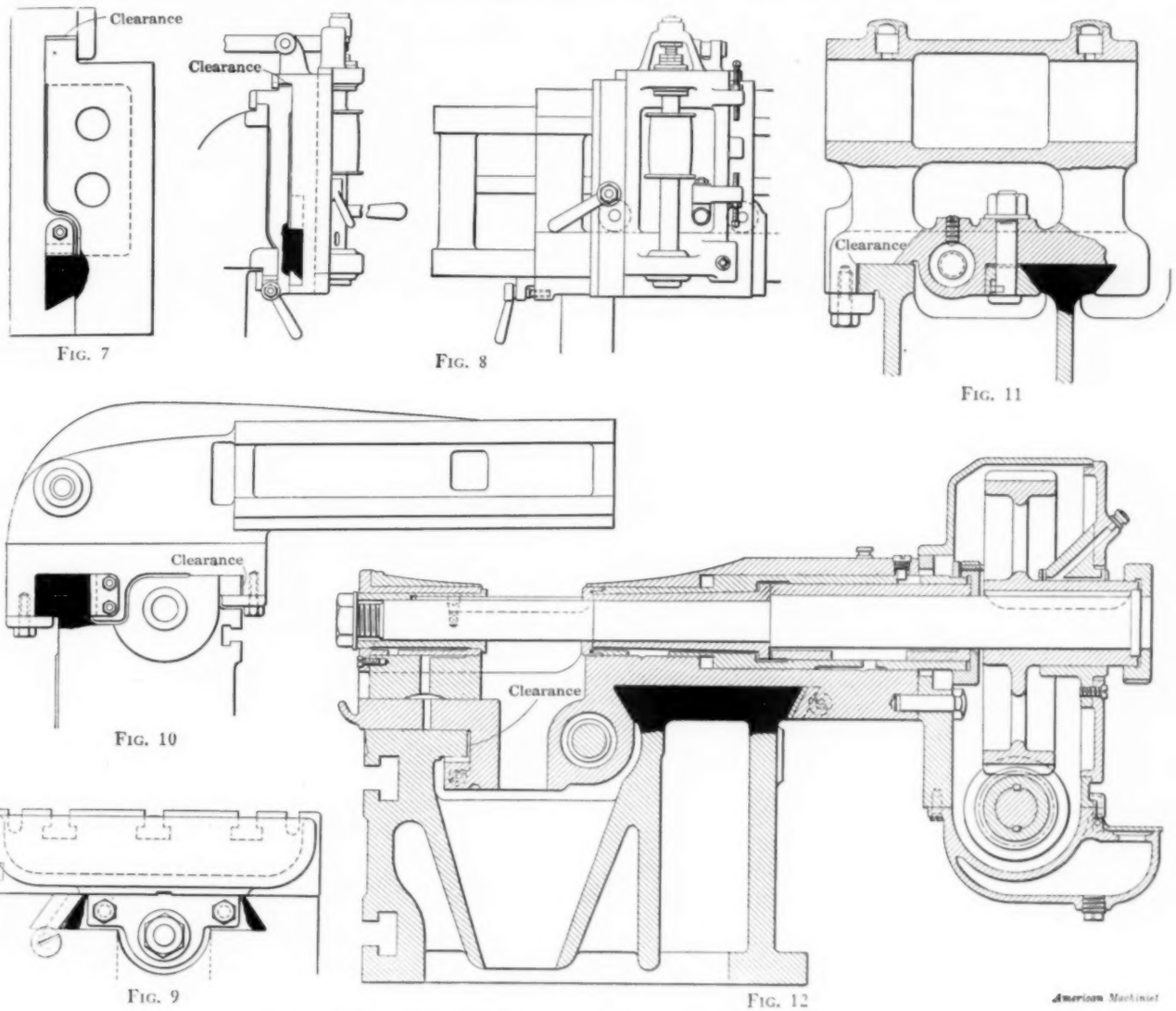


Fig. 7 Fig. 8 Fig. 11

Fig. 10

Fig. 9 Fig. 12

The Narrow-guide Principle in Machine-tool Construction

a cross-rail and saddle for a planer or a turning and boring mill. The guide here is found of much value, effecting a steady movement and feed to the saddle, which must of necessity be made short in comparison with its bearing width.

Profiling-machine slides form another good case for the use of a narrow guide, because light and delicate movements are required to make them responsive to the requirements of profile milling. This is why such slides are mounted on rollers to let them run freely, the rollers usually running on the top rail. In James Archdale & Co.'s practice these rollers run upon the top edge of the lower slide of an auxiliary saddle, Fig. 8, with a gib on the other edge, thus forming a narrow guiding way which gives good results.

Many milling-machine slides embody the principle, though it is not generally recognized, being somewhat disguised, as in Fig. 9. Instead of spanning the outer width of the bed slide, the table fits in the inside guide which results in a narrower width. Some lathe slide rests are also built in this way.

Side Planer and Gear Cutters

An exceptionally good case for the adoption of the narrow guide is the side planer, where a long, overhanging arm has to carry the tool box, and the twisting strains on the arm are most severe. In the machines built by George Richards & Co., Ltd., Manchester, the back shear of the bed only is used as a guide, Fig. 10, giving a width compared with the length of 1 to 11. The reason for using the back shear, instead of the front, which seems at first sight the proper one, is because the driving screw must be placed in front of the guide, if a twisting effect is to be avoided.

Several gear-cutting machines have the narrow guide embodied in their work spindle, or cutter-spindle slides. Both the Parkinson and the Darling & Sellers spur-gear cutting machines have their cutter slides fitted thus, smoothness of working with cutting and quick-return strokes being obtained, and greater accuracy of alinement preserved. Fig. 11 illustrates the work-spindle head of the gear cutters made by G. Birch & Co., fitting the dovetail edges of one shear of the bed. The Brown & Sharpe machines also have a narrow guide for the cutter slide, one example being shown by Fig. 12. Take-up jibs pushed endwise by screws are employed.

A Plea for the Untrained Worker

By Entropy

When we hear of a man being sentenced to prison for some crime, we are apt to say that if it were our case we would prefer to be hung and have it over with. Thinking along the same line I have been wondering if I would not prefer hanging to living the life that quite a considerable portion of our population live. There is a saying that one-half the world does not know how the other half lives. Read in the opposite way from that which was intended when it was first said, it appears to be fortunate that the poor do not realize how the rich live or they might rise up in the night and turn the tables.

How a man earning only $10 a week can enjoy life alone, to say nothing of raising a family, is beyond most of us; especially if there is no opening ahead of him. Yet these people do enjoy themselves, they do raise families, they do buy houses and when the occasion arises they spend money freely. Their children go to school alongside of those of their rich neighbors, dress as neatly and very often outstrip them in their school work.

Their children could not make the progress that they do if they themselves were not naturally bright.

If you get close to some of these people, get well enough acquainted with them so that you have a right to judge them, you will find that there are many whose dullness is simply ignorance of our language and our ways, whose slowness is due to lack of nourishing food. There is a great deal of ability not being utilized because we do not know where it is. We have a great human scrap heap in this country, largely made of the refuse of other nations, but still containing a percentage of good rough material that is well worth raking over the whole pile to get.

Taking Material from the Scrap Heap

Lately we have been delving into this scrap heap for mechanical material more than we ever did in the past. Here in the East we have been suffering for lack of skilled workers. The automobile manufacturers, the builders of heavy machinery and others who are prospering in the Middle States have been mulcting us of our men. They have been paying more money and sad to relate they have been treating them better, in some of the ways which appeal to a man, than we have here.

The result is we have been taking men into our shops and we have been breaking them in to run certain machines and do certain work, until many of our shops are crowded with operators who are doing as much work for at least as little money as we ever had it done for before. And yet we are uneasy and discontented. Why? Because it is not natural for a mechanic to continually see his work done by a man who is simply an automaton and because we very well see that the time is surely coming when we shall be stripped of our men who can break in these men.

We have come to expect to see our grinding machines and our screw machines, even our flat turrets, operated by men whose mechanical ability has no direct connection with what they are doing. Just because a man can be taught to measure with a micrometer and can be taught to put work into a jig does not make it at all follow that he could be taught to build the micrometer or the jig, nor can we as easily break in non-mechanics to set up machinery or to do the hand work of fitting up.

These men whom we have broken in so that they will stand over a given job day in and day out without hitching, have advanced only in a limited degree beyond their previous state on the human scrap heap. They have more permanent employment and a roof over their heads instead of working out of doors. They have no assurance and not much hope of more pay. Their advancement is unlikely because they did not come into the trade at the bottom. We have started these men in on work that we would have reserved at least two years in the case of a green apprentice. We have not given him the reason why. We have only told him to do so and so. He may be grinding work to quarter thousandths that to save his life he could not center, and his neighbor may be drawing the same pay for centering, and yet be unable to grind anything, not even an ax.

A Plea for Evening Training

I believe that there is enough material here that is worth while for us to develop. We cannot, during working hours, expect to do anything except get the work out of them for which they are hired. In spite of all that has been said about the inefficiency of evening instruction, I believe that there is a large opportunity for valuable work in just that direction with these men.

The Franklin Union

I happened into the new building of the Franklin Union, in Boston, the other evening. Benjamin Franklin did a lot of good things in his lifetime and he has just done one more thing out of his lifetime that redounds to his credit. He laid aside a comparatively small sum of money, to be invested and to accumulate for a long time and then to be spent entirely on the education of young

men who worked in the shops by day and could only attend school at night. The school has not been running much over a year and yet it has 600 or 700 pupils. The boys and men come in irrespective of age to learn to supplement their daily work. They do not do much with the trade that we are most interested in, which is natural as Boston is not very much of a machinist's city, but the principle still holds. The students have so great an average age that every attempt is made to make their surroundings different from those of the usual public schools. Instead of the usual seats and desks, they use ordinary chairs and small tables around which four can work. The drawing rooms look like dancing rooms, and the practice is on full-sized machinery.

What Such a Machinist's School Should Teach

If this was a machinist's school, our man whom we have initiated into grinding, would go there in the evening and learn how to center and rough turn his work ready to grind. He would learn to true his wheel, to grind work in a chuck, internal work, etc., so that if occasion came for him to leave his present job he could take a similar one without fear that the work, if at all different, would stagger him.

He might be running a gear cutter and come to the evening school to cut a bevel gear, or hob a worm gear or cut a spiral.

He might be drilling in jigs and come to learn how to lay out a job from a blueprint. He would have to have, as they do at the Franklin Union, teachers who were earning money by daylight at the very things which they were teaching in the evening, which is a point which has been overlooked in some evening schools in the past.

Then again most of the men to whom I have referred need something more than instruction in their trade. Many of them can hardly talk English, let alone write it. They need the most elementary education in this line and they need it patiently and persistently offered them, otherwise their fluency will be confined to the few cuss words that such men pick up so readily.

Open a Corner of the Shop for This Work

Now it is not necessary to wait a hundred years to get such a school. Every city has some organization, board of trade, Y. M. C. A., or what not, that is just aching to show its usefulness in just such a way. Open up a corner of your shop to them every other night. Let them hire some of your leading workmen as teachers. It won't cost much in comparison with the good it will do. You can afford yourself to give them the use of the machinery, the heat and light and power. They will not make anything that you can sell, possibly they might make enough to pay for the material, but that will not be much.

What these men need is not the entire machinist's trade, that would take too long. They need just snatches here and there to make what they are doing in the shop intelligible. They need individual instruction, there is little chance for instruction in classes, and while that appears expensive, it should be borne in mind that they do not need long courses.

I believe that we owe it to humanity to do something along this line to relieve the treadmill monotony of a life sentence to a machine shop, without an opening ray of light ahead, for I know of nothing more disheartening than to be a simple cog in a shop where a man who is out sick is of less consequence than a broken gear on the machine that he runs, and where he knows that nothing but the foreman's whim stands between him and discharge if work is not pressing.

The Importance of the Job

By the way, did you ever stop to think what a serious matter a $10-a-week job is to the man who has it? Did you ever think that the man who draws $10 a day gets work more steadily and worries less in the slack times than the one on $10 a week? It is serious to wives and children when you sack a $10-a-week- man, for a chance mistake or a fool speech. I know we all do it more or less. I have many a time discharged a man in anger and repented at leisure. In one shop where I had charge for a number of years, we used to be allowed to choose our help only from men who had passed muster in the office. Then I took their measure and the gang boss did the same. If we all liked a man we hired him. On the other hand, if the office people did not like the color of his hair, or the gang boss did not fancy the variety in his swear words, or I did not like the way his time cards ran, any of us could fire him. It was not right. I do not believe that any one man should have the right to discharge an employee. The ones who suffer from hasty decisions are not the men you turn out but their wives and children, and while you cannot be expected to lose money for their sake you owe it to them to go carefully.

Internal Grinding—V-Belts—Swedish Gages

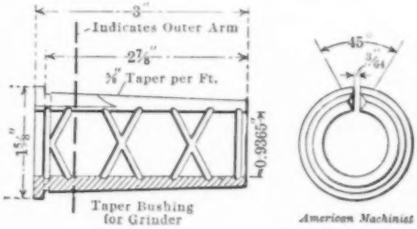
By E. A. Dixie

The bushing shown in the line cut is an extension arm bushing used in a Heald grinder. This is tapered as shown, split and fits in a taper hole. Obviously when forced into a taper hole the hole in it will spring out of round. At first the truing up of the center hole seemed quite a problem, but was overcome in a very simple manner.

The hole into which it fits in the machine is reamed with a taper reamer provided with a stop for depth. The grinding fixture was reamed exactly the same and these bronze bushings are after being ground on the outside and split, then forced into the fixture to the same depth they will be entered in their own place in the machine. The hole is then ground out to plug gage and the job is done.

V Belt for Grinder Spindles

The spindles of the Heald grinders have for some time been driven by 1¼-inch canvas or leather belts. These have been replaced by narrow leather belts. They are ½ inch wide on the outside and



Taper Bushing for Grinder

tapered 45 degrees on each edge. They run in corresponding grooves on the grinding spindle pulleys, but on flat driving pulleys, which tends to spread them so they always fill the grooved pulleys, and they pull better than the wide belts. The slippage on the wide flat belts is from 5 to 10 per cent. and on the narrow V-belt 1 per cent. The spindles are run at about 14,500 turns per minute.

Swedish Gages

I thought I had told all the good points about the Johannson Swedish gages, but the superintendent of a shop doing very fine work tells me that the ordinary extremes of heat and cold as found in the factory do not affect their size. He offered to prove it to me and some time I'll let you have the full particulars.

He also says that, since he has had a set of these gages with which to check up the miscellaneous micrometers, verniers and other gages in the shop, and which is done periodically, he has no trouble in the assembling department. After the component parts of a machine have been passed by the inspectors with gages corrected to the Swedish gages there is no trouble in the assembling department.

MAKING CHAINS by HAND and MACHINE

Methods Used in Making Chains for Hoists as Well as for Battleships' Anchors

EDITORIAL CORRESPONDENCE

It may not be generally appreciated that nearly all the chains used in hoists, cranes and for almost any purpose sustaining loads, are made of wrought iron and welded by hand. This has been found better and safer in most cases than any machine welding, especially for chain carrying loads, and which might cause serious damage or injury to workmen. Of late, however, we are informed that some makers of small hoists are using an electrically welded load chain.

a block, which measures its pitch, if the term can be applied to a chain of this kind, one of these blocks being shown in the foreground of Fig. 1.

This shows a chainmaker who has grown old at the business, bending up a link from a heated bar, preparatory to cutting it off. Back of the anvil is the "dolly," which is a pivoted fuller, arranged to come in the right position on the upper side of the link to be welded, which is held on a side horn projecting

in the hand-welding process. Of course, the material is cut off to a uniform length, and even if the links are not lapped to the same distance, the pitch will not be materially affected if the welded portion is brought down to the same diameter as the rest of the links. Needless to say, the heating of the rod, both before and after bending, is carried on very systematically, so that there is a piece always ready to work on and no time is lost in this way.

FIG. 1. BENDING THE LINK

FIG. 2. WELDING THE ENDS OF THE LINK

The chainmaker belongs to a clan, with very few exceptions coming from a small district in England, known as Blackheath, which is near Birmingham and comprising Cradleigheath, Staffordshire and the surrounding district. These men seem to be born into the business and become remarkably skilful in this line of work.

PEG AND BLOCK CHAINS

The chains are divided into two classes, known as "peg" chain, which is simply welded over a peg and is not smoothed out or dollied, no attention being paid to the links being of uniform length. These chains are, of course, unsuited for chain hoists, and for this purpose a better grade known as "block" chain is required. This derives its name from being fitted into

from the anvil, as can best be seen in Fig. 2. After cutting off the link is threaded through the chain already made and welded, as can be seen in Fig. 2. It will be noted here that the dolly is of larger size and operated by foot power, which changes its name to "Oliver," blows being struck by foot pressure on the treadle instead of by hammering on the top of the dolly as in the other case. This name is supposed to come from the fact that the original device used took the place of a helper whose name was Oliver.

SIZING THE CHAIN

Fig. 3 shows the sizing of the welded links to fit the chain blocks, and it is surprising the uniformity that is obtained

As an evidence of this we cite a few instances from the output of the Frankford Chain Works, where these illustrations were secured. With chains made from 17/64-inch bar there are 1442 links, weighing 73 pounds per hundred feet of completed chain, and a man makes on the average of 128 pounds of this size chain in a week of 55 hours. This figures out about 32 links an hour for the whole 55 hours during the week.

On chains made from ⅜-inch rods there are 1180 links, weighing 136 pounds per hundred feet, and of this size a man makes about 300 pounds in a 55-hour week. On ½-inch chains with 891 links, weighing 255 pounds per hundred feet, a man makes about 475 pounds in 55 hours, which requires very steady and rapid

FIG. 3. SIZING THE CHAIN

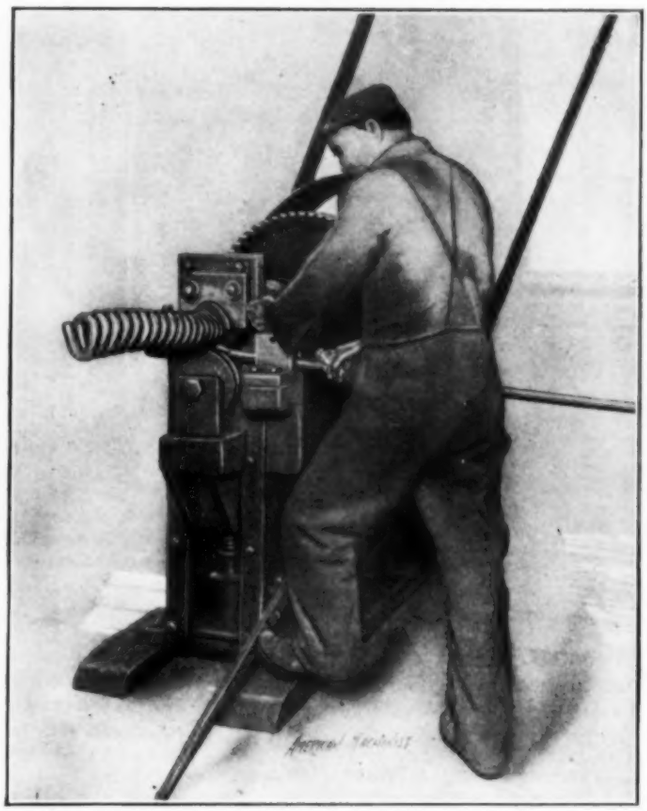


FIG. 4. ROLLING THE COIL OF LINKS

work, such as can only be done by a man of long experience.

MACHINE WELDED STEEL CHAINS

There is, however, a large field for a cheaper grade of chain, such as the hand chain for hoists and a lot of similar work. While steel has a higher tensile strain than wrought iron, it also crystallizes much more readily and is less dependable on that account. Then too, there does not seem to be the same certainty about securing a good weld, and it has never replaced wrought iron on really important chains.

Fig. 4 shows the way in which the links are formed direct from the rod, which is run between the rollers shown and around a mandrel, which gives them the desired shape. This is done cold, and as can be seen requires a very solid machine as the bars runs up to ¾ and 1 inch in diameter. After leaving here they go to the shearing machine shown in Fig.

FIG. 5. CUTTING THE COIL INTO LINKS

FIG. 6. WELDING INTO A COMPLETE CHAIN

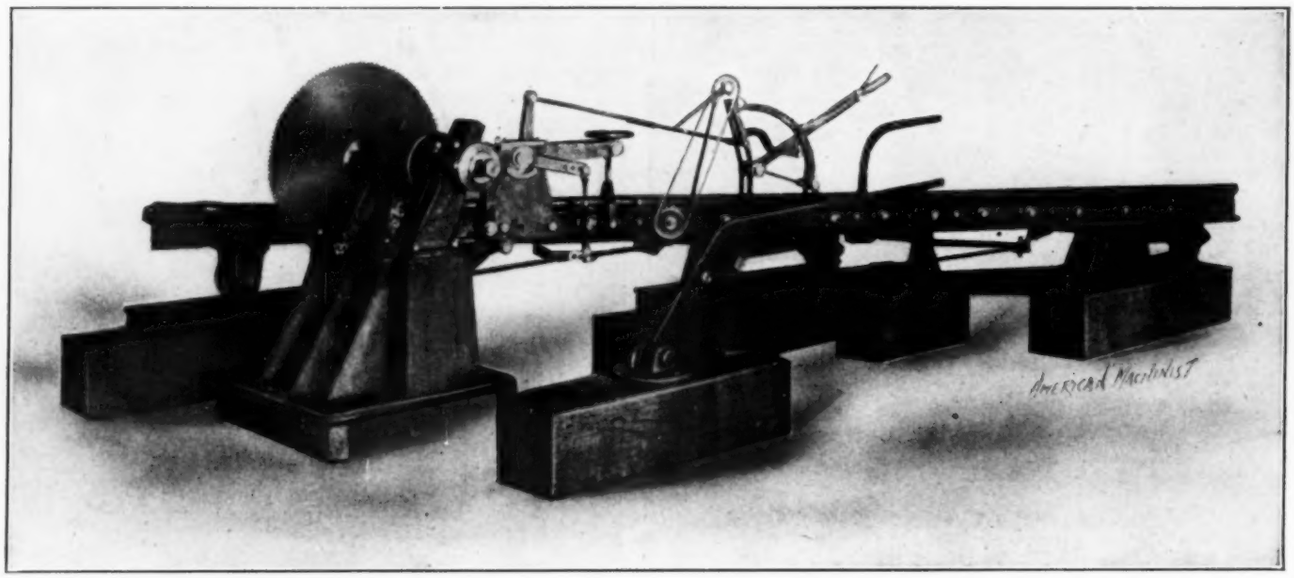


FIG. 7. SAWING UP THE BARS INTO BOLTS

5, which carries a chisel at the proper angle so as to cut the desired scarf for welding, as can be seen from the link already cut on the floor.

WELDING WITH A POWER HAMMER

The welding is very similar to the other chain, except that it is done by power, the blow being secured by the form of hammer shown. A cam will be noticed under the hammer arm, this being fast to a shaft revolved by the pulley shown at the back. The blow is due to the heavy coil spring, coupled to the back end of this hammer arm, and the operator also uses his hand hammer for hammering down the projection and making a smooth-looking chain.

Some shops also use an electric welding machine for this purpose, in which case the ends of the links are usually cut off square and held in a suitable vise, which conducts the heating current to them and also presses them together when heated to the fusing point, so as to form a solid joint at the weld.

MAKING ANCHOR CHAIN

The forging of anchor chains for the large battleships is quite a different proposition from the smaller chains which have been described. As with the smaller chains, however, they are of wrought iron and have until very recently been forged entirely by hand.

A few years ago the question of chain making was taken up very thoroughly by Commander Henry E. Parmenter, U. S. N., retired, and he has developed a very interesting line of chain-making machinery, which is now installed at the Charlestown Navy Yard, Boston, Mass. He is, so far as we know, the first man to successfully weld the link in a machine instead of by hand, and in so doing he makes use of a squeeze weld, which is entirely without blows or shock of any kind. This is based on the assumption that if blooms can be successfully welded into a solid mass by being passed between rolls, and this is entirely without blows of any kind, other welds can also be made this way.

CUTTING THE "BOLTS"

Beginning with the cutting up of the bars into bars or "bolts," as they are called, the saw shown in Fig. 7 is used for this purpose. Bars are all cut hot; the first cut chops off the ends at an angle of 30 degrees, then the operator throws in the feed roll and the end of the bar goes against a stop which turns the whole bar so that the cut will not be parallel, and the next cut is made. This is done to allow for the twisting of the bar while being bent into the form of a

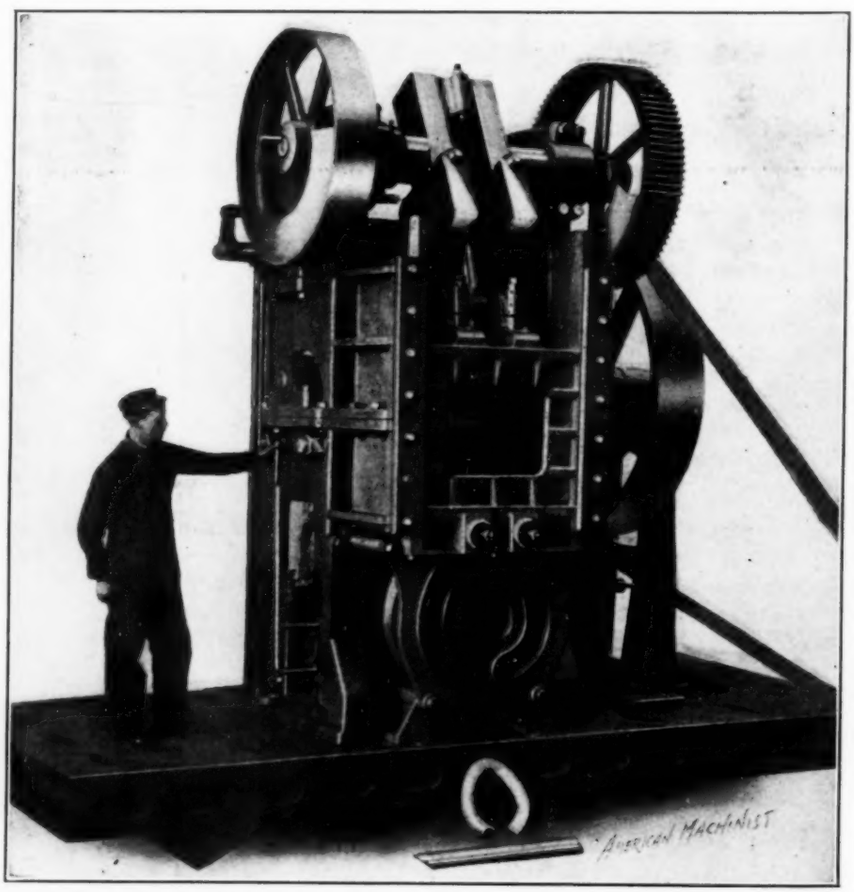


FIG. 8. BENDING THE LINK

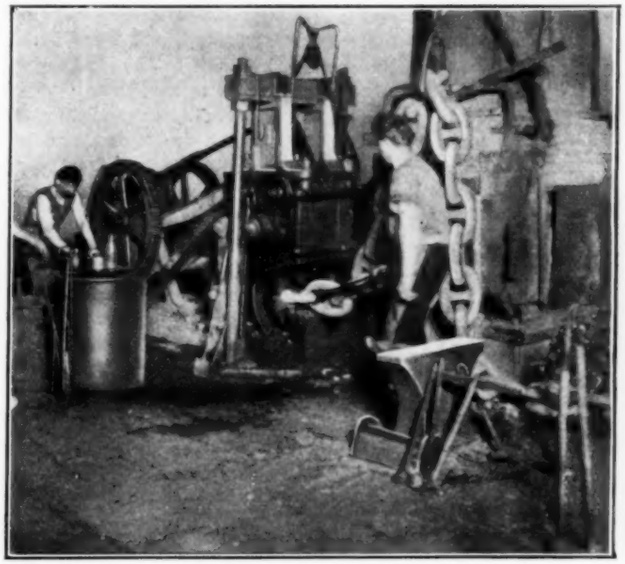


FIG. 9. WELDING THE LINK

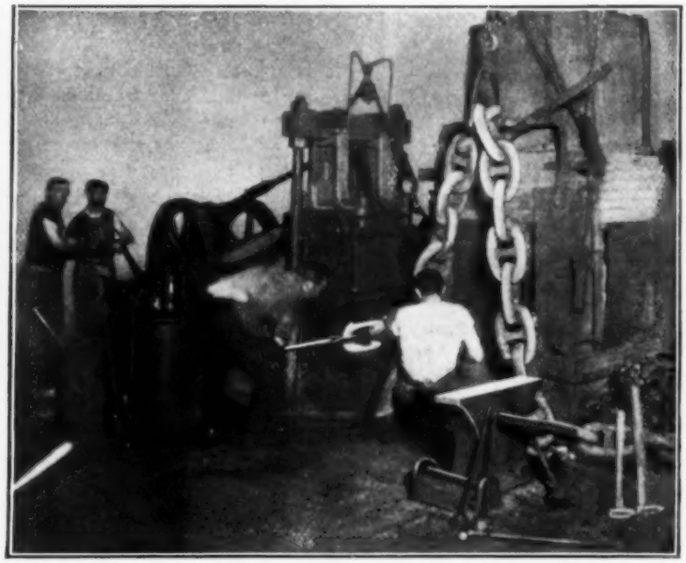


FIG. 10. PUTTING IN THE STUD

link with the end left open and an amount sufficient to thread through the link already completed.

There are five links from each bar, which requires six cuts, including trimming the ends, and these are completed in two minutes, which is as fast as the bars can be rolled and handled. The saw is made of boiler plate, is 36 inches in diameter, and has a long form of tooth cut to a very acute angle. This runs 2125 revolutions per minute, making a cutting speed of about 20,000 feet per minute.

Beside the saw in the link-bending machine, which bends them at the same heat, the entire operation of sawing and bending requires but two minutes for five links. In the case of 2¾-inch chain, such as is illustrated in these views, these bolts are about 38¼ inches and weigh approximately 65 pounds each. This machine is shown in Fig. 8.

THE WELDING MACHINE

The links are now ready for welding, and go into the other department to the welding machine, shown in Fig. 9. The ends are threaded through the previously finished link, then heated in a coke fire and when they have reached a welding heat are held under the welding machine, as can be seen. The scarfed ends are placed between the dies, which are forced together and make a perfect weld as is proved on every chain, for every anchored chain must be tested to a given strain. For the present these welding machines are operated by hand from the back by the use of a heavy gear reduction, but they will be operated by hydraulic pressure when the new system has been thoroughly installed. The edges of the weld are dressed down with sledges instead of being cut off and a remarkably good-looking link is made in a short time when the size is considered.

The link is now ready to receive the stud, which is a drop forging, milled on the end to fit the curves at the side of the link. These are inserted, as shown in Fig. 10, and the link squeezed together in another pair of dies in the same machine, in front of the welding dies, a comparatively light pressure being sufficient, as the contraction of the link in cooling helps to hold the stud firmly in place. The object of these studs is to prevent the chain from being entangled or fouled, as a sailor would say. When finished these links measure 9⅞ inches on the inside and about 15½ inches over all.

SOME INTERESTING FIGURES

After looking at them it is not easy to see how anchors are ever carried away, as is often the case, until we stop to consider that a battleship weighs from 16,000 to 18,000 tons, that when these are being knocked around on the waves it

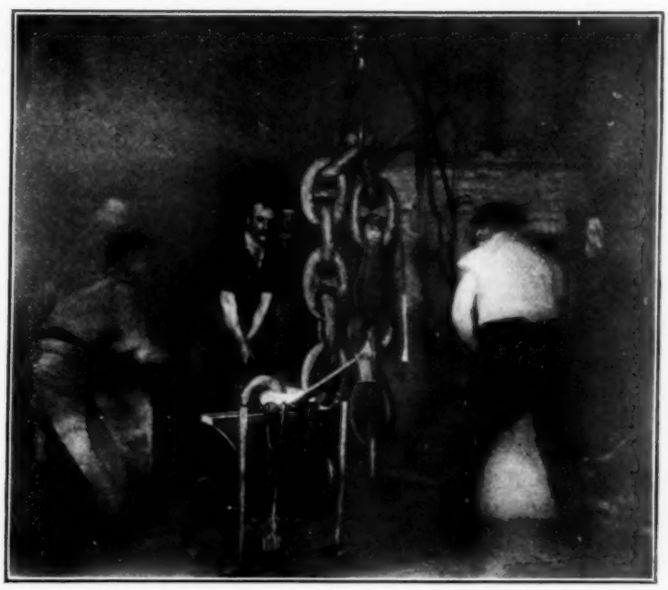


FIG. 11. WELDING A CHAIN BY HAND

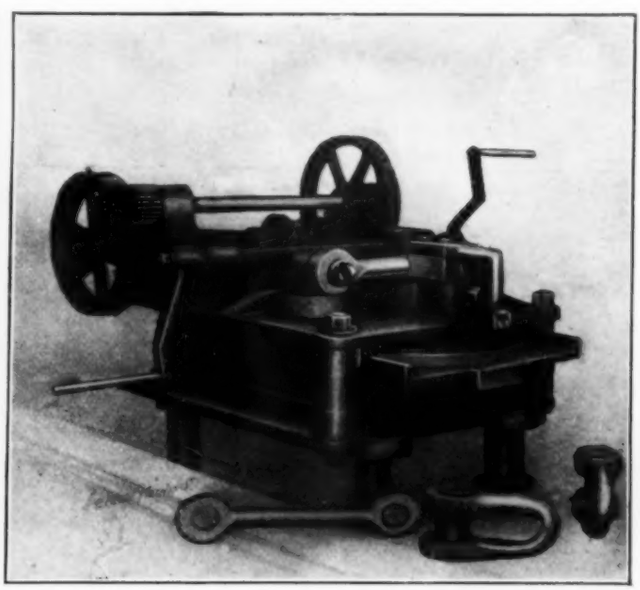


FIG. 12. SHACKLE-BENDING MACHINE

puts an enormous strain on the anchor chain.

Each battleship carries 135 fathoms, or 810 feet of anchor chain. These are made up in "shots," which is the nautical term for lengths, of 5, 15 and 40 fathoms, or 30, 90 and 240 feet, these shots being connected by shackles.

Every chain is tested as a whole, the test for a 2¼-inch being 262,302 pounds, and three links are taken from every shot of chain and tested till they break. The breaking strain of this size chain is 443,069 pounds, and if any of the links break at a lower strain the whole shot of chain is rejected. Chain of this size weighs 440 pounds to the fathom.

An interesting example of the contrast between hand and machine welding can be had by comparing Figs. 9 and 11. In the latter there are three sledges at work on the weld and in some cases four are used. The striking is an interesting example of rhythm, as it is absolutely necessary for them to keep in perfect time, or the interference would be sure to prove disastrous. The picture shows how the swivel is used to connect two shots of chain.

Bending without Stretching

Fig. 12 shows a very interesting machine in the shape of a shackle bender, also designed by Commander Parmenter. Bending like this has a tendency to reduce the cross-section of the shackle at the center owing to its being stretched in bending. This is prevented in this machine by putting an end pressure on the shackle being bent, which will offset any tendency to stretch. The eyes of the shackle are first forged, and after being heated in the center, it is fastened to the heads shown by pins in the eyes.

The bending is accomplished by the use of two flat cam plates which operate at the lower end of the block that holds the shackle in place. The cam in the upper plate can be readily seen, as the plate projects beyond the machine. The lower cam plate moves directly beneath this and in the opposite direction, the combination of the two movements swinging the two ends so as to bend the shackle around the center mandrel shown and also compress it sufficiently to prevent any stretching and a consequent reduction of area. This requires very careful laying out for the cams, but accomplishes the desired result in a very interesting way.

Measuring Dovetails of Angles

By Charles Eisler

I have had occasion to build many special machines in which dovetails were used. It may assist some of the readers of the American Machinist to know how such dovetails can be measured very quickly and without calculation.

Fig. 1 shows a finished part in which the male should be fitted as shown in Fig. 2. First draw a line any hight from the bottom surface *A*, as at *B*, say, half the hight of the dovetail, or take any scale ½ or ⅝ inch wide, hold it on surface *A* and draw the line *B* as shown in Fig. 1, then take the same scale and hold it to surface *C* and draw lines *D D*¹ as shown in Fig. 2. After one side is finished, marked *E* in Fig. 2, measure the exact distance *B B* with a pair of trammels, simply holding a scale *A* on the side *B* to find the right distance *B B* as shown in Fig. 1. When measuring be sure and hold the trammel points exactly between the part *G* and the scale *A*. After having measured *B B* use the same scale *A* in the same way and holding your trammel points between line *E* and scale *A*, draw an arc *J* to cross line *D* and then simply plane through the crossing of the two lines *D* and *J* and you will have the size required.

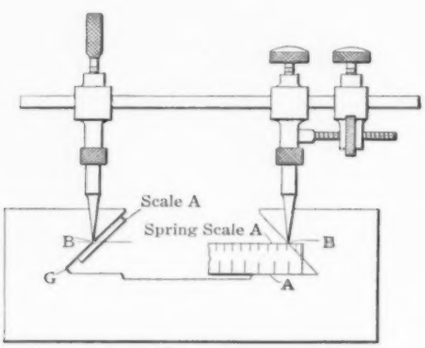


Fig. 1

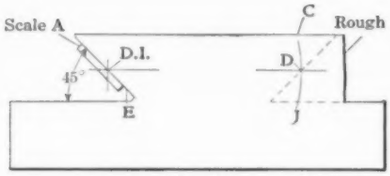


Fig. 2

Fig. 2 shows one side finished and one side rough; the sizes can very easily be obtained finished and unfinished.

Dovetails with Gibs

These can be measured in the same manner. The only difference is, instead of holding the scale *A* on the side, take the gib required as shown in Fig. 3, and draw your arc in, the same way as in Fig. 2. Draw lines *D D* through the gib; on the outside of the gib make a very small punch mark *H* so that it will be exactly on the line *D* and insert your trammel points in the punch mark *H* and draw arc *J* crossing *D;* then plane through the center of the lines *O*, which will be the distance required for any angle.

Fig. 4 shows both parts fitted with gib. Of course the hight *F F* is measured the usual way. I have measured this way for many years, and it has proved very satisfactory. Allowance can be made for scraping.

This way of measuring may be an old one, but still new to some of the readers of the American Machinist.

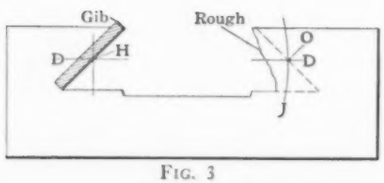


Fig. 3

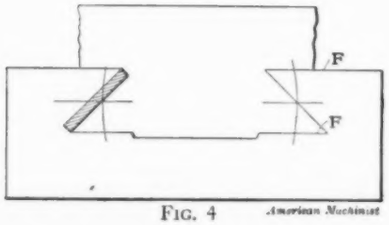


Fig. 4

Measuring Dovetails

According to the *Brass World*, the best bearing bronzes are those which are free from zinc and high in lead. When zinc is present, it seems to cause heating. The present high speed obtained in some of the large railroads has been made possible by the use of bearing bronzes high in lead and practically free from zinc.

A Few Special Tooling Methods

The Vermont Farm Machinery Company, Bellows Falls, Vt., have paid special attention to the tooling of their Potter & Johnston automatic lathes, which are largely used in the making of parts for their cream separators. A general view of some of these machines is seen in Fig. 1, the machine in the foreground being fitted up for turning the spindles, which can be seen on the floor in front of the machine.

Where there are only two operations, as in this case, they make a practice of double tooling these machines so as to save time in indexing past the empty holes in the turret. Fig. 2 is an enlarged view of the hollow milling tool used on these spindles, the tools being very large and heavy as compared with the work, and to further insure rigidity, the tool passes through a massive bushing or guide, which gives almost continuous support over or near the cutting point. The toolholder is a heavy casting, carrying two cutting tools at the front end and performing a very difficult operation in the most approved fashion.

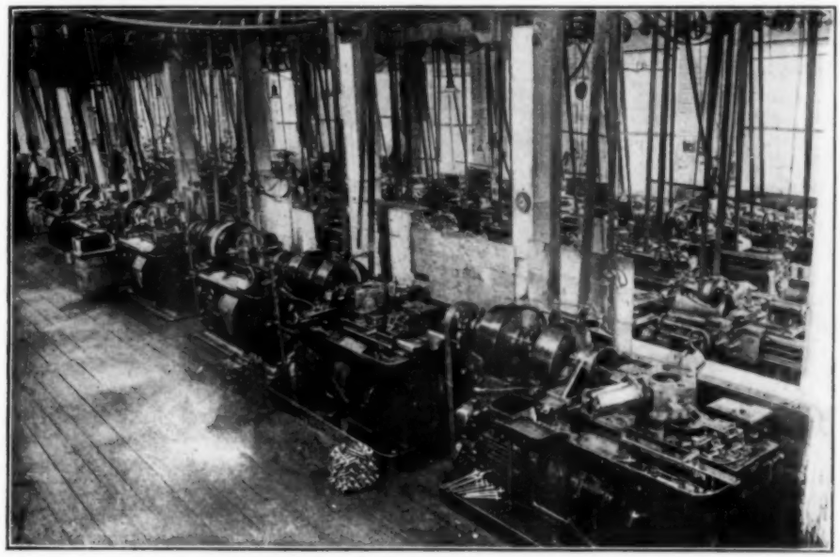


FIG. 1. TURNING THE SPINDLES

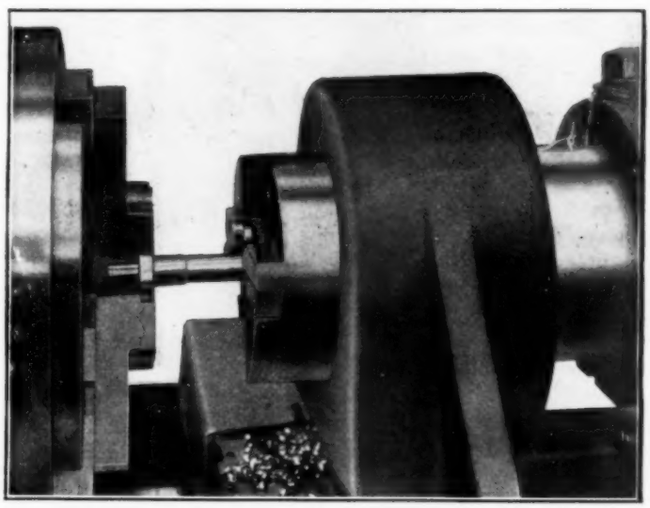


FIG. 2. SUPPORTING A HOLLOW MILLING TOOL

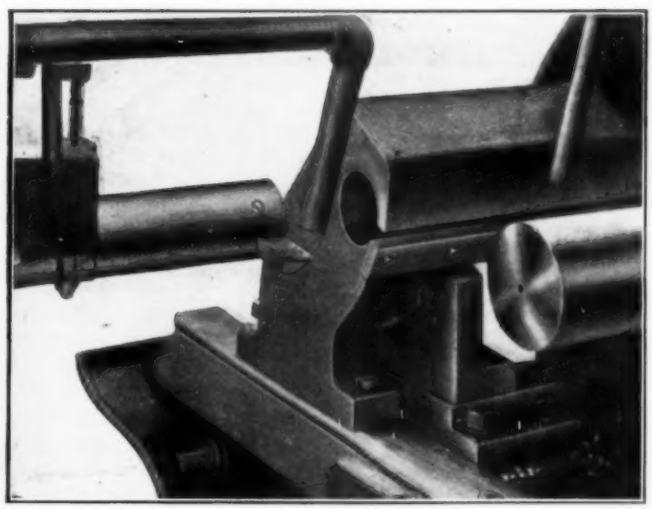


FIG. 3. SUPPORT FOR TURNING TOOL

These spindles are of high-carbon steel and it would be next to impossible to turn them in the usual way. The toolholder in this case is a heavy casting hinged at the back and the tools are normally held apart by a heavy spring. The tool is pushed over the work to the proper position, and the guides closed around it, the cut being taken from the chuck out to the end. This allows back resting on the turned surface and makes an easy way of doing a difficult job.

While the double tooling of small screw machines is quite common, this is the first instance we know of where this method has been applied to as large a machine as this.

TWO NOVEL TOOL GUIDES

One of the operations is the turning of a rather long piece projecting from the chuck, and Fig. 3 shows how the outside turning tool is held in the turret and guided while at work, so as to prevent all springing away from the work under the cut. The turning tool is held in a

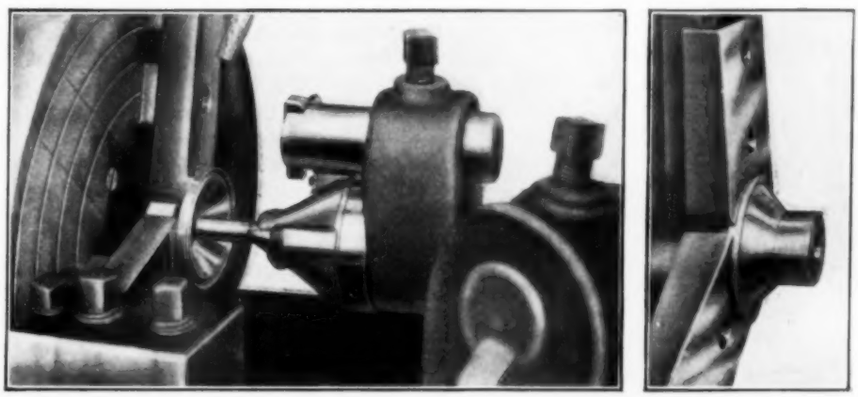


FIG. 4. TWO EXAMPLES OF FALSE JAWS FOR HOLDING WORK

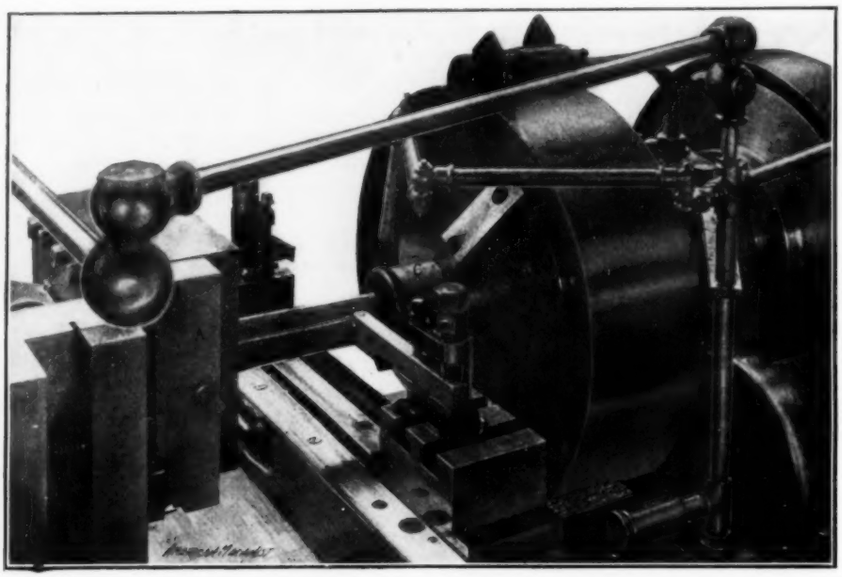


FIG. 5. SUPPORTING BORING BARS IN THE BOWLS

round bar, the same as a boring tool, and on the cross slide is a substantial support which guides the end of the bar carrying the tool during the entire length of the cut. This supports the turning tool with equal stiffness during the whole cut and allows very accurate turning to be done at a rapid rate.

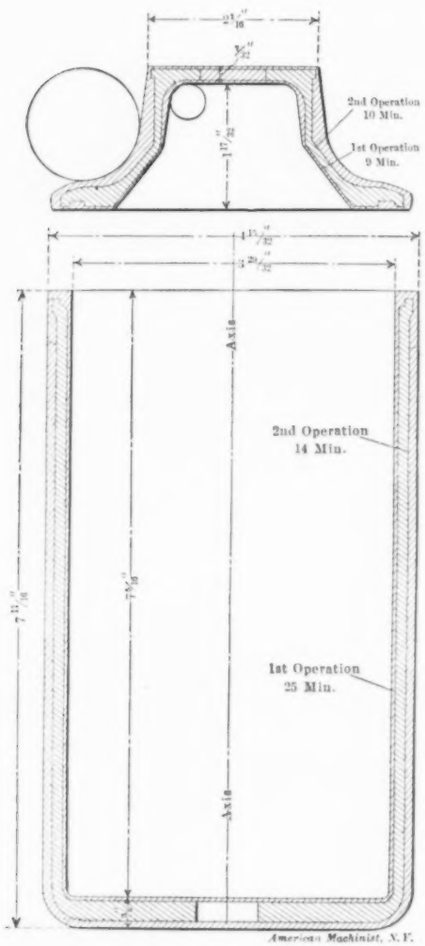


FIG. 6. THE BOWL BEFORE AND AFTER FINISHING

The separator bowls must run at from 8000 to 9000 revolutions per minute and have to be turned perfectly true inside and out. They are first bored in the Potter & Johnston with the tools shown in Fig. 5, which shows another method of supporting the cutting tool while at work. Here the boring bar *B* is held in the fixture having a cross slide *A* for adjusting the bar for each cut and allowing it to be moved to the right position. The back side of the bar has been flattened to give a good bearing for the hardened-steel roller held in the end of the supporting bar *C*. This in turn is held in the back tool post of the cross slide. A heavy spring tends to throw the slide *A* so as to keep the cutting tool away from the work and against the supporting roller in *C*. When it is taken into consideration that the material used contains 50 points carbon and 95 points manganese, and is subjected to a special heat-treatment to stiffen it, all before machining, raising it to practically a tool steel, the results are more surprising.

In this way the position of the cutting point, which determines the diameter of the hole, is governed by the support *C* in the cross slide, and after the hole has been bored its full length, the cross slide is moved backward and allows the boring bar to be withdrawn without touching the work. The supporting roller is used as near the end of the piece being bored as possible, and while it cannot follow the cutting point during its entire travel, as in the support of the outside turning tool in Fig. 3, it is of great assistance in securing holes that are true and straight.

The bowl is then turned on the outside in an engine lathe, being held on an expanding arbor for this work. The bowl is shown in section in Fig. 6, the finished size being readily seen inside the other lines.

Two examples showing the use of false chucking jaws for holding work can be seen in Fig. 4. These are being held for the second operation, the jaws being specially fitted to the work so as to secure accurate running and also avoid injury to the work. It incidentally shows the tools used in boring and turning the inside and outside of the conical cup at the same time.

The method of hobbing a very steep pitch worm gear having six threads is shown in Fig. 7. The gear itself is light and of narrow space and is supported on a substantial base, which is as nearly the outside diameter as possible and is held in place by the covering or clamping plate *A* of the same diameter as the base. In order to insure quick handling, holes are drilled through the top large enough for the flanges of the nut *B* to pass through easily, and it only requires a very slight turn of the handle *H* to bring the large holes in line with the bolts after they have been loosened, when the plates can be easily lifted off and a new gear

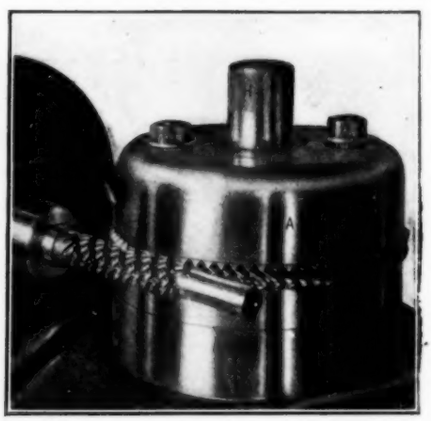


FIG. 7. CUTTING STEEP-PITCH WORMS

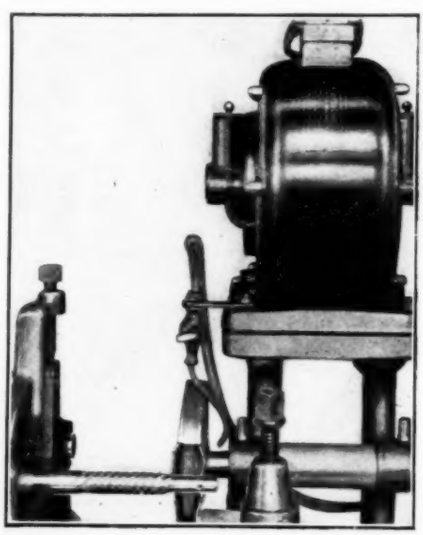


FIG. 8. A GRINDER FOR THE LATHE

put in place. In practice the outer end of the hob is supported by the overhanging arm of the milling machine, but this was removed in order to make the illustration more clear. It is almost needless to say that the worm-gear blank is driven by positive gearing, while being cut.

A Substantial Lathe Grinder

Fig. 8 shows a grinding attachment fastened to the back of the lathe carriage and used for grinding the ends of the spindles, such as are shown projecting from the steady rest at the left. This consists of a substantial stand carrying both the grinding wheel and the motor, power being obtained from a lamp socket overhead. The driving belt comes down on the right-hand side and is not shown in this illustration. It will be noted that the grinding wheel is almost completely encircled by a hood and also that either water or air can be brought down to the wheel and the work.

Testing

When the parts are ready for the assembly room, the first thing that receives attention is the bowl, which is tested for balance. It is readily understood that the slightest variation from true would cause a pound at the high-speed and the balancing test is for the purpose of eliminating any pound. This is done by readjusting the parts and when too great the addition of weight to the light side. So accurately are the parts inspected when made that readjustment is rarely necessary. When the machines are finally assembled they are belted up and run for a number of hours. Sensitive testing instruments are used in testing the worm and worm wheel, each thread being required to come within the limits of 0.002 inch.

We are indebted to both Mr. Williams and F. E. Newell, president and superintendent of the company, for the information secured.

Shop Growth and the Handling Problem *By Warren H. Miller*

Shops, especially large manufacturing establishments, have a great way of growing. If a wise forethought has located the original shanty somewhere out in the rural cornfields, where thrifty mechanics can own their own grapevines and garden patches on far less wages than city life demands, then the selling-end will be able to offer better goods at less prices than the other fellows, and orders will tumble into the "main office" like bees in a hive. Each order breeds a number of shop orders, and they in turn hatch out a goodly crop of stock orders. And, meanwhile, the plant grows and grows, for land is cheap; and here a wart is built to take care of some operation crowded out of its own department, and there a scrap bin is torn down to make room for a new structural-steel shop. The "old foundry" is converted into a forge shop, while a new one rises where the cinders used to be dumped; the boiler shop moves out of doors and camps out under tarpaulins until a larger one can be built and no matter where you look, the old buildings are bursting out at the breeches and elbows, until all the lean-tos, sheds and warts that can be added to them will not hold all the work that is to be done.

Presently the general manager finds that, either he must put all the company's profits into teamster's hire, or else have a general reorganization of the works' stockhandling facilities. As a general rule the foremen of the various shops have gotten their own methods of handling material into pretty fair shape. There is a "dead line" on the floor, beyond which anyone leaving a casting is shot at sight; three-wheel shop trucks with broad flat treads move piles of work from one operation to the next, and, an overhead crane, if need be, keeps busy transferring this and that up and down the shop.

But outside! Here are 150 tons a day of raw material tumbling in from the work sidings, and about the same going out, and the works comprise, say, about forty buildings, spread over a square mile of ground. There are casting yards, flask piles, pig yards, steel racks and lumber piles, here and there, and all this has to be distributed to them, fed out from them to the various departments and the half-finished work of one department transferred to another, without any of it interfering or doubling unnecessarily on its tracks.

Of course the industrial railway is the only solution of all this, using push-cars and Hungarian horsepower for the lighter work and the electric storage-battery locomotive for anything five tons or over. Between the two might be suggested the electric truck, for, even with good track, our zealous foreign prime-movers give up at anything much over 1½ tons. For all this lighter work, 16 lb. to the yard, industrial rail, 18¾-inch gage, spiked to 3x9-inch yellow pine sleepers, spaced 2-foot centers, is plenty good enough.

Besides the flat trucks universally used with this light track, probably the best car to handle quantities of small forgings and castings is the rock-elm wooden-body, iron-bound, side-dump car. This may splinter some, and does rapidly deteriorate in service, but this wood lasts longer than any other, and new boards are plentiful and cheap, whereas the same car in steel will soon accumulate a collection of dents and buckles that preclude the possibility of ever closing its door with any reasonable tightness.

For storage-battery locomotives of from 1½ to 10 tons, hauling from 10 to 50 tons about the yard in cars of about 1½ tons capacity, the 36-inch gage, 30-pound rail with pressed-steel ties for yard track and longitudinal pine sills under the rails in the shops, is far cheaper in the end than the lighter tracks. Most shop managers look upon the storage-battery locomotive with impatience because the creature is in considerable ill-repute, due mostly to the unsavory reputation of the storage battery itself. Now, however the batteries supplied with locomotives are built especially to withstand very rough handling and the old objections no longer hold. This has been accomplished by doing away with the old "grid and pellet" plates and substituting plates whose active substances are developed in themselves by electric action. The electric truck and locomotive are as quick as the electric crane itself in getting about the shop, and, as they will haul anywhere from ten to fifty tons of trailers, they are just the thing to handle big quantities of any one product and save all the annoyance of the dozens of little trips taken by the push-truck for the same purpose.

For purely inter-shop service, probably the 2½ and 3-ton storage-battery locomotives are the best sizes, using a 200 ampere-hour storage battery and hauling about ten tons, as most shop tracks can be kept reasonably true and level. But, for yard work, the 6-ton and 10-ton sizes are incomparably better, as they can work in any weather, haul from six to twenty cars of ashes or ingots or pigs, and work hard all day with only a supplemental charge at noon.

The 6-ton locomotive for yard work has a maximum haul of about twenty tons, at which point it will slip its wheels unless the track is better graded and the cars in better condition than is found in most industrial plants. With two 7½-horsepower series motors and a 110-volt 300 ampere-hour battery, it will haul five cars of ashes, coke, or gravel, over grades from one to 1½ per cent., curves of 25-foot radius, all sorts of rough-and-ready trackage and stand it steadily for eight hours before coming spent. For handling lmuber, steel, pig, cement or such stock about the yard, this size is most excellent for a works covering one or two square miles of territory.

The track fittings for these locomotives should not be home-made, as the 6-ton locomotive is no joke to jack up and get back on the tracks; besides, all its works

are hung low and apt to get smashed when it runs overboard. The rails should be not less than 30 pounds to the yard and turntables of sheet steel with cast-iron rollers in a machined spider. Turn-outs and switches should be substantially made with steel sole plates and ties. While the usual radius for 36-inch gage is 25 feet, an electric locomotive taking 70 amperes on the straight run, will run up to 200-250 going around such a curve, while it will increase to only about 100 amperes on an easier curve, say of 36-foot radius. This is a strong argument in favor of easy curves.

In practice it has been found that five miles per hour is fast enough for these locomotives, to allow time for the crew to handle switches, etc., conveniently.

With reasonable care and supervision these locomotives will run year in and year out and cut down the teaming bills enormously, besides requiring a good deal less forage and repairs than is needful for mule-power. The cost of the 6-ton size is about $2700 and the 2½-ton $1900, including batteries, motors, truck, cab, and full equipment. Only a few simple requirements need be heeded in its upkeep.

A Quickly Made Drilling Jig

By C. H. Rice

In the sketches I show a jig-drilled gear wheel and the jig, respectively. There is nothing unusual about this jig save perhaps the method of making it. In Fig. 1 is shown the job. Forty-eight of these gears were wanted for a new idea in 24-inch shapers, and to save time in laying out and to enable us to use cheap labor, it was proposed to jig the job; but if money was to be saved, the jig must be quickly made, and here is how it was done:

Of course, the main hole was bored out in a lathe, and all turning done; the teeth were cut, and the gear was ready for drilling. A single gear was set up on parallel blocks, carefully laid out, and two holes being "spotted" with the first drill, two tap holes were drilled in the disk, and the screws put in. This small piece was then "shaped" to a sliding fit in the slot *a*. The small piece was deep enough to enter the slot *a* about 1/16 inch or so, while the disk was resting on the points of the pins, in the holes.

The center clamping pin was made of cold-rolled stock and a ¼-inch hole was drilled in to receive a holding pin, to prevent the pin from turning when the top nut was tightened. Now, the templet being put in place and the nut tightened, a babbitt hammer was used to strike lightly on the plate over each point, thus forming an impression on the center of

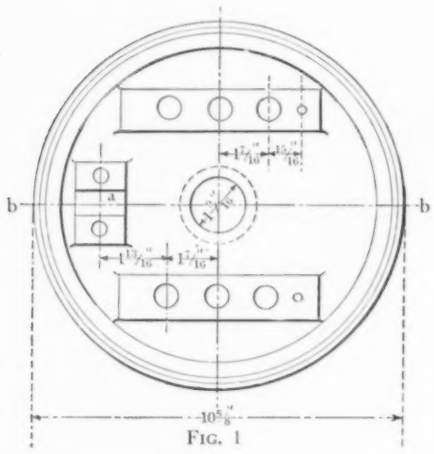


FIG. 1

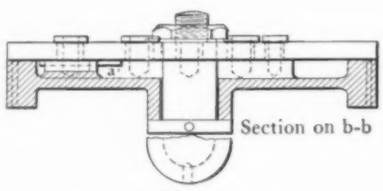


FIG. 2
Jig in Position for Drilling, and all Holes Drilled.

American Machinist

DRILLING JIG FOR SHAPER STROKE GEAR

the holes, ¼, ⅜ and ½ inch, put in and reamed. Then drill rod, of these three sizes, was turned to a conical point, and cut off just long enough to reach to the bottom of the holes, and allow the sharp point to extend about 1/16 inch or so above the planed surfaces of the gear. A cast-iron plate was then swung in the lathe, bored 1 9/16 inches; a disk cut out, 10⅝ inches, put on a mandrel and faced both sides to ½ inch. Across this disk, a center line was struck. A small piece, approximating the size of the slot *a* in width, was drilled for two ½-inch screws, flat head, and countersunk; this piece was centered, placed carefully on the center line on the disk, clamped, and each hole below. The templet was then removed, the holes scribed off, drilled and reamed, and in this condition the jig was put to work, the bushings being made meanwhile, in case more of these gears should be wanted. In Fig. 2 I show the bushings in the jig to make the job look right, although the work was done without them by a boy.

It should be stated that a drill working through a cast-iron templet has such a tendency to wander around that the boy had to be prepared, as well as the jig. He was taken over to the bench by the foreman and instructed to see, first, that his drills were ground right; second, if an opening showed around the drill, "shut 'er down"; third, feed light, by hand, until the drill was down ¼ inch or so; and fourth, to "center" his drills, before starting the machine, to avoid cutting up the jig.

I wanted to do a little special grinding on the body of the drill, using, of course, an old drill that was about used up anyway; but the "old man" said "no," so we wound up the job in the manner described.

The engineering night school has a large field of activity. At the start its students have a clear idea of commercial practice such as is seldom possessed by the newly graduated college student. This early experience instils an appreciation of the value of time and of scientific training that tends to produce the most efficient student. They have learned several years earlier in life than the college student that scientific study and commercial practice go hand in hand; that there never comes a time when the one can be laid aside and the other taken up. They also know the importance of the routine of life, that from the office boy to the president, it is the fellow who gets the job done that gets the bigger job to do.—C. R. Dooley in the *Electric Journal*.

International Mechanical Engineers Meeting

A joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers is to be held at Birmingham, England, July 26-29, 1910.

Papers to be presented have been arranged so far under the three general subjects of Roundhouse Practice, Electrification of Railways and Tooth Gearing. Papers on other subjects are under consideration and it is possible there will be a topical discussion on high-speed steels. Various technical excursions to points of interest in and around Birmingham are contemplated.

The steamship "Celtic" sailing from New York July 16 has been chosen as the official steamer for the members of the society.

LOOKING the APPRENTICE PROBLEM SQUARE in the FACE

Looking at the Question from Both Sides

BY FRED H. COLVIN

In considering the question of apprenticeship as with any other problem, it is best to look the situation squarely in the face, to study the existing conditions from all points of view and clear our minds of the notion that either one side or the other has all the virtues or all the vices on the calendar. If both had more of the former and less of the latter, the problem would be much simpler in every way.

As a matter of fact the apprentice question has been in a chaotic condition for ten years or more, beginning with the increasing introduction of special machinery when shop managers began to dimly realize the futility of training a boy as of old to do all kinds of work, when they only wanted him to run one kind of machine from one year's end to another. Someone, who probably lacked the faculty of getting on with boys, pronounced apprentices a nuisance, a relic of barbarism in the machine shop, a money-wasting institution and other equally objectionable things and declared that he was done with them forever. Apprenticeship was out of date, boys were unreliable, never had paid what it cost to train them, and the new order of things left them entirely out of the question, so that many shops discontinued taking apprentices without figuring it out for themselves.

Some Did Not Agree

A few made a careful study of the question and decided that apprentices must be trained anyway, that they did pay if they were handled right, and so continued to take them on in the same old-fashioned way, paying more attention however, to the manner of training and the results obtained. They also recognized the growing of specialization, of the need of workers who could run a certain kind of a machine well and who need not know how to run any other, and proceeded to train men of this kind. These came usually from the bright handy men or laborers, who were older than the apprentice, and to whom it opened up a higher field of usefulness than snagging castings or carting sand.

Makers of special and automatic machines claimed that unskilled help only was necessary, and the idea that boys must be trained in some line of shop work gradually faded away in most shops until apprentices became hard to find.

Admitting that the times have changed and that the old-time apprenticeship is past for the majority of workers, we still face the necessity of obtaining some general machinists, and a large percentage (and it is growing larger every year), who must be trained in one particular branch of the trade.

The Boy to be Trained

Hardly any one will deny that a boy with a taste for mechanics, who intuitively understands the principles involved after a very little teaching, is to be preferred. And there is no trouble with boys of this kind when you can get them, they are usually bound to learn the trade and succeed. Yet there are many who prefer men or boys who will do as they are told without asking or caring why, when it comes to looking after an automatic machine of any kind or on special work. This feeling accounts for the large number of foreigners who cannot speak English, in some large shops filled with automatic machinery. They are more tractable, more a part of the machine itself, than a man who thinks. Instead of being blamed for thinking only of "6 o'clock and pay day" as of yore, this is their chief qualification. But there is room for argument on this point, as a glimmer of intelligence and interest is not out of place, even on an automatic machine.

Many shops, however, are earnestly and honestly trying to get boys and to train them to be a credit to the trade, for there are shops which take pride in making good workmen as well as good machines and good dividends. They are all equally necessary to the industry. Shops of this kind, where a boy is told frankly and honestly what is expected of him and what he will be taught in return, have very little trouble with boys "jumping the contract," if there is a human interest shown in his welfare. In too many cases the chances of advancement are painted in ultra rosy colors, and when the boy finds that he becomes a very small cog in a very big machine, when he sees men who (possibly with good reason, but he cannot see that) have been running a drill press for years, he naturally gets uneasy and, perhaps foolishly, tries to better himself elsewhere.

We expect a boy to work faithfully, to do his best to learn and make a good showing in both quality and quantity, which is as much to his advantage as to ours. But do we often look beyond our own shop and think of the time when the boy goes elsewhere to work? For while we are not training boys for the other shop, he may have to go there to work some day. Should not his learning of the trade fit him for the average shop rather than to our own special methods only?

That this is not a fancied condition can be readily proved in several cases, where boys who are well trained for their own shop are not in high favor in any other shop in the locality on account of their being unable to handle work by usual methods, being accustomed to the use of special tools and fixtures for all work. Wherever the boy is trained, in shop or school, or both, has he not the right to demand such a training as will fit him for average shop conditions so that he may do himself justice in any shop he may work in? Or if this cannot be done, to have some allowance made for it, or at least to know beforehand that he could not receive a complete training in that shop. For there is a duty *to* the boy who spends three or four of his golden years in learning a trade as well as a duty *for* him to work so as to be of value to the shop. Nor should we lose sight of the fact that the industry as a whole depends on the efficiency of the individual, no matter what his position.

The cry from all quarters is where to get the boys, until one might think there was a shortage in the boy crop if we did not know to the contrary. We are apt to think that the present day boy isn't as ambitious as we were and we are prone to make a virtue of our necessity of getting up at 5 a. m., forgetting that it was a compulsory virtue, and that we loved the sound of the alarm clock just as little as our boy does today. But do we ask ourselves honestly why the boys do not flock to our shops and beg to be taught? Do we try to consider from the boy's point of view, what the machinist's trade has to offer in comparison with other occupations? To those of us who love machinery and its making, it may seem to be the only trade worth considering, but if it appealed to the average boy as much as some other occupations, would there be such a shortage?

When customers continue to buy our competitors' machines, we look the situation over as calmly as possible and try to see where we are lacking. So if we fail to secure recruits for our branch of the industrial army, it is better to know why they go elsewhere than to soothe

our feelings by calling it the perversity of the boy. If we use half the tact in handling the boy that we display in making a sale, we can probably net a larger profit than in any other way.

Put yourself in the boy's place and you would find yourself considering the questions of personal comfort, a warm, light shop, windows free from bars or white paint to shut out all sight of the outside sunshine; sanitary and safe conditions; the chances of accident and what would happen both physically and financially; hours and wages (and here you might possibly find that the machinist's trade did not offer the greatest inducement for the skill required); the probabilities of the future in the way of work and its remuneration, and last but not least, the real human interest in you and your work. You wouldn't mind being a mere number on the time clock, but you'd much prefer to have the boss think of you as John.

Training Methods

In spite of long-founded ideas to the contrary, many well known and highly practical men have been forced to the conclusion that it does not pay to train boys in the average shop. The rush of getting out work, the lack of time for instruction on the part of the foreman and others, and the delay from the boy keeping a machine out of use, or being in the way, all had an effect in forcing out the apprentice in many places. For this reason, there is an increasing number of advocates of the trade or training school where the boy can be taught the foundation principles of shop work and become familiar with the operation of the machines used. A year or two in a good training shop, such as the Milwaukee School of Trades or that of the General Electric Company, at Lynn, Mass., gives a boy a better general knowledge of the trade than he can get in the average shop in double the time. And he will go into the regular shop better qualified to handle almost any work than the average machinist who comes along. He will not, of course, be as proficient as a thoroughly experienced man, for no school can give much actual experience in two years, but he will be in condition to make every day's experience count because of the foundation back of it.

The contention of some, that the shop itself is the *only* place to learn a trade, is losing ground in many quarters, as there are few shops which can or will provide proper instruction or prevent the training from being interfered with by the zeal of the production department. The shop management is too prone to forget, or does not realize that the training of good men must always precede the proper and economical production of machinery and is just as important to the industry.

This does not mean that there are not shops which can and do teach a boy the trade or parts of it, in the shop and on commercial work, for some shops do this and do it well, but they are the exception. And the question of economy must come into the training of boys as well as into the production of machinery.

What and How to Teach

No one has yet solved the problem of what to teach and how to teach it. The Schneider plan is excellent to give mechanical-engineering students a shop training, but the crying need is not for mechanical engineers but for good shop men. Roughly speaking, we need perhaps two hundred machinists to every mechanical engineer and there is no great shortage in the latter supply.

The Fitchburg, Mass., modification of the Schneider plan comes much nearer the mark, taking every alternate week of the high-school course. But we must not overlook the fact that thousands of boys, boys who would make good machinists, never can go to high school at all. In fact, it may be asked with all seriousness whether a high-school boy will make a better machinist than one who goes to the shop directly from the grammar grades. This must not be taken as against the highest education a boy can secure, only as to its effects on his becoming a machinist, which is the point that we often overlook.

This brings us to the question of what it is necessary to teach a boy to make him a first-class machinist. This depends on what we consider a machinist should know and how much initiative he should have. But all will argue that he should know the three R's, at least to be able to handle such shop mathematics as figuring his pay, lathe gearing, speed of work, etc., while a general knowledge of the principles of mechanics often saves time and money for all concerned. Beyond this, it is a question with most of us, except the average instructor, who never gets away from the idea of making a mechanical engineer out of every boy in the shop and has almost no limit as to the instruction deemed necessary.

No course of instruction that I have ever seen could be accused of having too little in it; most of them have at least double what would seem to be necessary. In fact, it is a pretty safe rule to first decide on what problems a machinist should be able to solve and teach him as little mathematics as will enable him to do this easily. If he has a desire for more, you cannot prevent his getting it if you try, and he should be encouraged in every way. He should know how to read drawings although he need not be a draftsman in any sense. If he knows how to draw, it will be very useful to him, but many a first-class machinist cannot draw a bolt that would be recognized as such. This is another weak point with many instructors. If they cannot make a mechanical engineer of the boy, they hope at least to turn him into a draftsman. This speaks well for their desire to help a boy advance as far and as fast as possible, but it does not help the making of machinists, of men who can and will build machinery.

This does not tend to make a boy contented in the shop as it emphasizes the good points of another branch, while we are too apt to neglect showing him the best side of the shop work.

The correspondence schools too, are responsible for much of the discontent and class feeling that exists. They harp on "getting out of the shop," and "on the other side of the desk" and "give orders instead of taking them," until a boy gets the notion that life isn't worth living unless he can keep his hands clean, wear a fancy vest and sit at a roll-top desk and boss somebody, no matter who. There is no doubt that these schools have helped thousands to fit themselves for good positions or that anyone who can complete the courses finds the results worth much more than they cost.

They might have helped more to become better *machinists* if they had not held out the hope of putting them all on the other side of the roll-top desk.

Advantages of an Instructor

Whether the trade be taught in the shop or in a trade school, the old conditions are no longer satisfactory in any but a very small shop handling a variety of work, surely not in modern manufacturing. The boys should not be turned loose, but should have an instructor who can instruct, and it seems better in most ways to have the boy away from the regular shop, a section of the shop being set aside in some cases. This is an impressionable age, both mechanically and morally, and it means much to have him get the right foundation in both cases. A pessimistic old timer can sow more seeds of discontent in a week, than an instructor can offset in a year, and this also holds good with the other end of the question.

A good instructor with the boys under his supervision can teach them to do good plain work in a very short time. This should be such parts of the regular work as they can handle to advantage and still be learning. The work itself should be strictly commercial, parts of actual machines that are being built. The moral effect of making "things" that are to be scrapped as soon as they have been sufficiently admired, is distinctly bad. It does not teach commercial accuracy and lacks the incentive that attends the making of real machine parts.

The making of commercial articles also reduces the cost of instruction, and

could at times, probably eliminate it entirely. But in any case there is little doubt that a careful and thorough instruction will fit a boy to be a producer more quickly than by the old plan. The modern idea is that the boy should be paid while learning, whether in the shop or in the school; this being absolutely necessary in many cases, as some of the best boys must be self-supporting.

The tendency seems to be toward public institutions for this purpose, as in Milwaukee, Worcester, etc., but one cannot but feel that unless *all* trades are taught, it is shifting the burden which belongs to one industry to the whole people, which cannot be perfectly fair at all. And the feeling is growing that the cost of anything which belongs solely to an industry, should be borne by that industry as a fixed charge, instead of being shifted to the shoulders of others.

While the idea of training boys in the shop itself still has a firm grip on our minds, a careful study will show the many obstacles in the way of making this even moderately successful. Our foremen are busy every minute with details of shop orders and the production of machinery. Nor can we put the boy under the wing of a journeyman because he is trying to make every minute count in getting out his full quota of work for the day and cannot be bothered with a boy asking questions and playing pranks. For boys will play pranks at times, just as you used to do, in spite of time clocks, card systems and all the rest. But they are not half as annoying in the training department as they are where the regular work is under way.

If your shop is so organized that you can really train boys in the old way, in good shape, there is no objection to it. But if your son wanted to learn bookkeeping, would you let him work with your own accountant, or go to a business school to get the foundation laid where it can be taught quickly and without interfering with your regular work?

And if you do train boys in your own shop, don't make the mistake of expecting them to depend on evening schools. The days for that have gone by. Many of us did it to be sure, but it is an open question whether the shops did not more than pay for it the next day.

The Personal Note

In the old days when all shops were doing general work so that a man could go from one to the other, when the owner knew all his men and their families, the men were interested in the shop and its success. Conditions have changed as to shop methods, but the value of real interest in the work is as vital as ever. Men who say "we" and talk about "our shop" as of old, mean more to a shop than many realize, and any system which restores this feature of the old apprentice days, will be well worth careful consideration.

Whether we call it apprenticeship or not, whether we can figure it out that it pays or not, boys must be trained to be skilled workmen. The farmer might as well claim it did not pay to sow his seed in the spring and still expect a harvest in the fall. We must have skilled men and somebody must train them.

And while men are competing for employment in the industries, the various industries must also compete for the best men or the best boys, or else take the "left-overs" from those trades which seem more desirable to the boys, who are more free to pick and choose than the the average man with a family.

The industry demands skill and efficiency more than ever, if we are to maintain our high standing as machine builders the world over, and it is useless to deceive ourselves as to any part of the problem. We must have skilled machinists and good operators. They must not only be well trained but well treated, or they will naturally drift into a more congenial industry if one is to be found. It is useless to talk about the hardships we endured in the old days and how much better off men are now. Even if it is all true, it does not change the human tendency to secure the most comfort possible for the least exertion. It is time we laid aside all preconceived notions as to the "only way" and looked at the other side of the question as well as our own, even if the vision is not just as we might wish to have it, and work together for the general good of the industry at large.

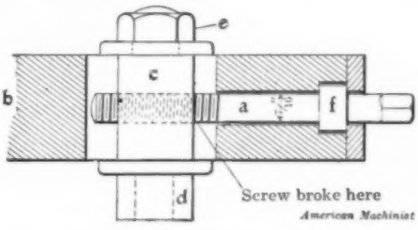
Cleaning Threads and a Header Repair Job

By M. F. Bates

Recently there have appeared in the American Machinist several devices for cleaning the threads of faceplates and chucks. These were fresh in my mind one day when I found an old faceplate that had a groove cut across the threads somewhat below their full depth. I suspected at once that someone had put it there for the purpose of cleaning the threads on the spindle. It seems to me that a similar groove cut across the threads of the spindle nose would make an effective combination for the purpose, would be automatic, and could not be mislaid or lost. But who is going to cut his spindles that way?

Some time ago a two-stroke heading machine began breaking a certain adjusting screw frequently, some lasting, however, much longer than others. It was working an $\frac{1}{8}$-inch soft bronze wire at the rate of about 125 blank screws per minute. The sketch shows the screw at *a*. A square slide *b* carries the shear which cuts the wire to length, positions it in front of the die and retreats for the next stroke. The block *c*, located in a slot, is provided with a roller *d*, which engages with a reciprocating cam. The purpose of the screw *a* is obvious.

I was convinced that the failure was caused by the nut at *e* not being tightened after adjustment, but the operator was positive that he had not neglected this. The nut was a good fit on the threads. On placing a broken screw in position, I discovered what had deceived the operator. The shoulder at *f* on the screw was too long so that when the cap was in place it turned hard. Since allowing the proper amount of freedom at this point no further breakage has occurred.



A Header Repair Job

Repairs are executed on orders accompanied by the broken parts. The broken adjusting screws had been carefully duplicated with the result that as many as six failed before the cause was looked into. The operator, of course, had been intrusted with replacing them.

A special compilation just made by the Bureau of Statistics forcibly calls attention to the fact that automobiles are a rapidly increasing factor in international commerce, the value thereof entering the world's markets in 1909 having exceeded 50 million dollars, against 9 million in 1902. France leads the world as an exporter of automobiles, with the United States second in rank. Statistics compiled from the official publications of the countries named show that the exports of vehicles of this class in the latest year for which details are at hand, were: From France, in 1908, $24,569,000; the United States, in 1909, $8,667,397; the United Kingdom, in 1909, $7,610,267; Italy, in 1908, $5,533,000; and Germany, in 1908, $3,031,000.

The Court of Patent Appeals

By Irving D. Kimball

The question of patent litigation conditions has again been brought to attention by the filing in Congress of House Bill No. 14,622, providing for a Court of Patent Appeals. It will be recalled that a similar bill was filed in the last Congress, hearings were held, it was favorably reported by the Committee on Patents, and referred to the Committee on the Judiciary. The bill died with that Congress. The present bill is the same as the former bill after it had been amended by the Committee on Patents. As the new bill has been referred directly to the Committee on the Judiciary, it should only require a report from that committee to bring it up for definite action by Congress.

The Plan

This bill provides for five judges, the chief justice to be appointed for life by the President with the advice and consent of the Senate, the other four to be appointed for terms of six years by the chief justice of the Supreme Court from among the judges of the circuit and district courts. This court to determine all appeals from the circuit courts in patent cases.

The Advantages

Prior to 1891 appeals from the circuit courts were determined directly by the United States Supreme Court. The circuit courts of appeals which were established at that time took over these appeals to relieve the Supreme Court. These courts of appeals are nine in number, the country being divided into nine districts. Each court determines appeals from the circuit courts in its district. The Supreme Court will, if it thinks a case of sufficient importance, accept and decide an appeal from a circuit court of appeals.

This plan has been very unsatisfactory in patent cases. A decision in one circuit court of appeals district has no effect in any other district. This makes it possible for a patent to be declared valid in one district and to be declared invalid in some other district.

The great volume of work before the Supreme Court makes it very difficult to get an appeal carried to that court, so that these inconsistencies remain without settlement.

An Illustration

To understand what may occur under such conditions it will be of interest to refer to the patent to Arthur W. Grant, No. 554,675, dated February 18, 1896, for a rubber-tired wheel.

On December 27, 1896, the Circuit Court for the Southern District of New York upheld the patent saying that it "discloses patentable invention, and was not anticipated by anything in prior patents, either English or American, though the several parts which constitute the essential features of the invention were each used in different combinations in previous inventions."

Later, the Circuit Court for the Northern District of Ohio, in an unreported decision, also upheld the patent. An appeal was taken from this decision and on May 6, 1902, the Circuit Court of Appeals for the Sixth circuit gave a decision that "The Grant patent No. 554,675, for a rubber-tire wheel, is void for lack of patentable invention, being merely a combination of old elements selected from devices of the prior art, resulting in no new mode of operation, and in which the parts perform only the old functions in substantially the old manner." A petition to the Supreme Court for writ of certiorari was denied.

The following month, June 2, 1902, the Circuit Court for the Northern District of Georgia decided that "The Grant patent No. 554,675, for a rubber tire wheel, shows a combination of elements in a rubber tire, which although such elements severally were old, brings them to bear in such way, and with such relation to each other as to differentiate such tire from all prior inventions, and to produce new and useful results, such as to re-inforce the presumption arising from the issuance of the patent and sustain the claim of invention, as distinquished from the mere application of mechanical skill."

In July, 1906, the Circuit Court for the Southern District of New York again sustained the patent and on appeal to the Circuit Court of Appeals for the Second circuit the decision was affirmed. In June, 1908, the same court of appeals again held the patent valid. The patent is therefore invalid in the sixth circuit and valid throughout the rest of the country.

If a patent is declared invalid in one district and valid in the other eight, a manufacturer can make the patented articles in that district and ship them to all the other districts. If a patent is declared invalid in one district, the public in the other districts cannot use the invention without being liable to suit in the courts of their district.

The judges of the circuit courts of appeals are called upon to determine appeals in many different legal lines. The questions of patent law and interpretation of the scope of patents require a particularly clear knowledge of such matters and this is not practicable when such a variety of different matters have to be settled. With a court of final appeal for the entire country composed of judges picked from among the circuit and district courts there would result a unanimity of patent decisions in appealed cases by experts in that particular line.

A decision by this court on an appeal from a circuit court decision would then settle the case for the whole country with a minimum of time and expense.

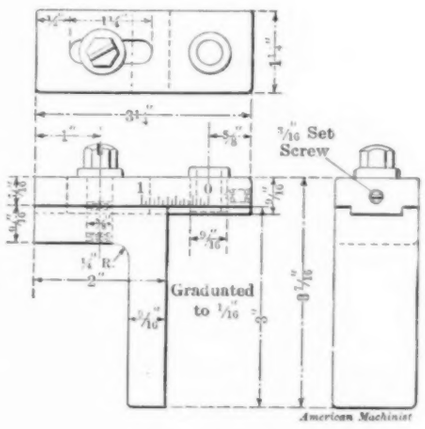
The patent question is of great importance and anything which bears such promise of good should be given a trial. It is likely; however, that some pressure will need to be exerted to get Congress to give attention to the matter as there is much for them to do and they will want to get home early this year in order to look after their fences.

A Doweling Tool

By G. E. Dawson

This little doweling tool is one that I have used and found to be very useful, especially when a neat job is required. It insures a perfectly smooth joint on the finished side of the boards; that is, when care is taken to clamp it in position on the smooth face of each board.

The collar screw and graduated slide afford a quick and independent means by which to set the center of the drill



Doweling Tool

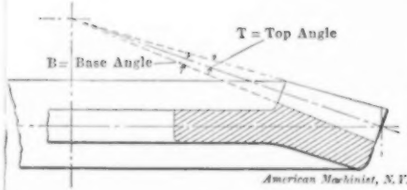
bushing, the required distance from the clamping face. By making a set of five bushings you will be equipped to drill for the following size dowel-pins: 1/8, 3/16, 1/4, 5/16 and 3/8 inch. Any of these bushings can be used by slipping into place and then tightening up the cone-pointed set screw.

The maximum range that can be obtained, from the clamp face to the center of the bushing, of the tool shown, is 15/16 inch.

Number of Teeth in Pinion.

Number of Teeth in Wheel.

		42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
12	T	2° 38′	2° 42′	2° 45′	2° 48′	2° 53′	2° 57′	3° 2′	3° 6′	3° 11′	3° 15′	3° 21′	3° 27′	3° 33′	3° 38′	3° 45′	3° 53′	4° 0′	4° 7′	4° 16′	4° 25′	4° 34′	4° 43′	4° 55′	5° 5′	5° 16′	5° 30′	5° 42′	5° 56′	6° 10′	6° 27′	6° 43′
	B	3° 2′	3° 6′	3° 10′	3° 15′	3° 19′	3° 24′	3° 29′	3° 35′	3° 40′	3° 46′	3° 52′	3° 59′	4° 6′	4° 13′	4° 21′	4° 29′	4° 37′	4° 46′	4° 56′	5° 6′	5° 16′	5° 28′	5° 40′	5° 53′	6° 6′	6° 22′	6° 36′	6° 52′	7° 9′	7° 27′	7° 46′
13	T	2° 37′	2° 40′	2° 44′	2° 47′	2° 52′	2° 56′	3° 0′	3° 4′	3° 9′	3° 14′	3° 19′	3° 24′	3° 29′	3° 36′	3° 43′	3° 49′	3° 57′	4° 3′	4° 12′	4° 20′	4° 29′	4° 38′	4° 48′	4° 58′	5° 8′	5° 20′	5° 32′	5° 45′	5° 57′	6° 12′	
	B	3° 1′	3° 5′	3° 9′	3° 13′	3° 18′	3° 23′	3° 28′	3° 33′	3° 38′	3° 44′	3° 50′	3° 56′	4° 3′	4° 10′	4° 17′	4° 25′	4° 33′	4° 42′	4° 51′	5° 0′	5° 10′	5° 21′	5° 32′	5° 43′	5° 57′	6° 10′	6° 24′	6° 39′	6° 54′	7° 10′	
14	T	2° 35′	2° 38′	2° 43′	2° 46′	2° 50′	2° 54′	2° 58′	3° 3′	3° 7′	3° 12′	3° 17′	3° 22′	3° 27′	3° 33′	3° 39′	3° 46′	3° 54′	3° 59′	4° 7′	4° 15′	4° 24′	4° 32′	4° 40′	4° 50′	5° 0′	5° 11′	5° 22′	5° 37′	5° 45′		
	B	2° 59′	3° 4′	3° 7′	3° 12′	3° 16′	3° 21′	3° 26′	3° 31′	3° 36′	3° 42′	3° 47′	3° 54′	4° 0′	4° 7′	4° 13′	4° 21′	4° 29′	4° 37′	4° 46′	4° 54′	5° 4′	5° 14′	5° 25	5° 36′	5° 48′	6° 0′	6° 11′	6° 24′	6° 43′		
15	T	2° 35′	2° 38′	2° 41′	2° 44′	2° 48′	2° 53′	2° 56′	3° 1′	3° 4′	3° 10′	3° 14′	3° 19′	3° 24′	3° 30′	3° 36′	3° 43′	3° 49′	3° 55′	4° 2′	4° 9′	4° 18′	4° 26′	4° 34′	4° 43′	4° 52′	5° 2′	5° 12′	5° 22′			
	B	2° 58′	3° 2′	3° 6′	3° 10′	3° 14′	3° 19′	3° 24′	3° 29′	3° 34′	3° 39′	3° 45′	3° 51′	3° 57′	4° 4′	4° 10′	4° 16′	4° 24′	4° 32′	4° 41′	4° 49′	4° 58′	5° 7′	5° 17′	5° 27′	5° 38′	5° 50′	6° 2′	6° 14′			
16	T	2° 34′	2° 37′	2° 40′	2° 43′	2° 47′	2° 51′	2° 55′	2° 58′	3° 3′	3° 7′	3° 12′	3° 17′	3° 22′	3° 27′	3° 33′	3° 39′	3° 45′	3° 52′	3° 58′	4° 5′	4° 14′	4° 20′	4° 28′	4° 36′	4° 45′	4° 53′	5° 3′				
	B	2° 57′	3° 1′	3° 4′	3° 8′	3° 13′	3° 17′	3° 22′	3° 26′	3° 31′	3° 37′	3° 42′	3° 48′	3° 54′	4° 0′	4° 6′	4° 13′	4° 21′	4° 27′	4° 36′	4° 44′	4° 52′	5° 0′	5° 10′	5° 19′	5° 29′	5° 40′	5° 50′				
17	T	2° 33′	2° 35′	2° 38′	2° 42′	2° 45′	2° 49′	2° 53′	2° 57′	3° 1′	3° 5′	3° 9′	3° 14′	3° 18′	3° 24′	3° 29′	3° 35′	3° 41′	3° 47′	3° 53′	4° 0′	4° 8′	4° 13′	4° 22′	4° 30′	4° 37′	4° 45′					
	B	2° 56′	2° 59′	3° 3′	3° 7′	3° 11′	3° 15′	3° 20′	3° 24′	3° 27′	3° 34′	3° 39′	3° 45′	3° 50′	3° 56′	4° 2′	4° 9′	4° 16′	4° 23′	4° 30′	4° 37′	4° 45′	4° 54′	5° 2′	5° 12′	5° 21′	5° 30′					
18	T	2° 31′	2° 33′	2° 37′	2° 40′	2° 43′	2° 47′	2° 51′	2° 55′	2° 58′	3° 3′	3° 7′	3° 12′	3° 16′	3° 21′	3° 26′	3° 32′	3° 37′	3° 43′	3° 49′	3° 55′	4° 2′	4° 8′	4° 15′	4° 22′	4° 29′						
	B	2° 54′	2° 58′	3° 1′	3° 5′	3° 9′	3° 13′	3° 17′	3° 22′	3° 26′	3° 31′	3° 36′	3° 42′	3° 47′	3° 53′	3° 57′	4° 4′	4° 10′	4° 18′	4° 25′	4° 32′	4° 39′	4° 47′	4° 55′	5° 3′	5° 12′						
19	T	2° 30′	2° 32′	2° 35′	2° 38′	2° 42′	2° 45′	2° 49′	2° 53′	2° 57′	3° 0′	3° 4′	3° 9′	3° 13′	3° 18′	3° 23′	3° 28′	3° 33′	3° 38′	3° 44′	3° 50′	3° 56′	4° 2′	4° 8′	4° 15′							
	B	2° 52′	2° 56′	2° 59′	3° 3′	3° 7′	3° 12′	3° 16′	3° 19′	3° 24′	3° 29′	3° 33′	3° 38′	3° 44′	3° 49′	3° 55′	4° 1′	4° 7′	4° 13′	4° 19′	4° 26′	4° 33′	4° 40′	4° 48′	4° 55′							
20	T	2° 29′	2° 30′	2° 33′	2° 37′	2° 40′	2° 43′	2° 47′	2° 50′	2° 54′	2° 58′	3° 2′	3° 6′	3° 10′	3° 15′	3° 19′	3° 24′	3° 29′	3° 34′	3° 40′	3° 45′	3° 51′	3° 56′	4° 3′								
	B	2° 50′	2° 54′	2° 58′	3° 1′	3° 5′	3° 9′	3° 14′	3° 17′	3° 21′	3° 26′	3° 31′	3° 35′	3° 40′	3° 45′	3° 51′	3° 56′	4° 2′	4° 8′	4° 14′	4° 20′	4° 27′	4° 34′	4° 41′								
21	T	2° 28′	2° 28′	2° 32′	2° 35′	2° 38′	2° 42′	2° 45′	2° 48′	2° 52′	2° 56′	3° 0′	3° 3′	3° 8′	3° 12′	3° 17′	3° 21′	3° 25′	3° 30′	3° 35′	3° 40′	3° 46′	3° 52′									
	B	2° 49′	2° 52′	2° 56′	2° 59′	3° 3′	3° 7′	3° 11′	3° 15′	3° 19′	3° 23′	3° 27′	3° 32′	3° 36′	3° 41′	3° 47′	3° 53′	3° 58′	4° 3′	4° 8′	4° 14′	4° 21′	4° 27′									
22	T	2° 26′	2° 27′	2° 30′	2° 33′	2° 37′	2° 40′	2° 43′	2° 46′	2° 49′	2° 53′	2° 57′	3° 0′	3° 4′	3° 8′	3° 13′	3° 17′	3° 22′	3° 26′	3° 31′	3° 36′	3° 41′										
	B	2° 48′	2° 51′	2° 54′	2° 58′	3° 1′	3° 5′	3° 8′	3° 12′	3° 16′	3° 20′	3° 24′	3° 29′	3° 32′	3° 38′	3° 43′	3° 48′	3° 52′	3° 58′	4° 4′	4° 9′	4° 15′										
23	T	2° 25′	2° 26′	2° 28′	2° 32′	2° 35′	2° 38′	2° 42′	2° 44′	2° 47′	2° 51′	2° 54′	2° 58′	3° 2′	3° 5′	3° 9′	3° 14′	3° 18′	3° 22′	3° 27′	3° 32′											
	B	2° 46′	2° 49′	2° 52′	2° 56′	2° 59′	3° 2′	3° 6′	3° 10′	3° 14′	3° 18′	3° 22′	3° 26′	3° 30′	3° 34′	3° 39′	3° 44′	3° 49′	3° 54′	3° 59′	4° 4′											
24	T	2° 24′	2° 24′	2° 27′	2° 30′	2° 33′	2° 36′	2° 39′	2° 42′	2° 45′	2° 48′	2° 52′	2° 55′	2° 58′	3° 2′	3° 6′	3° 10′	3° 14′	3° 18′	3° 22′												
	B	2° 44′	2° 47′	2° 51′	2° 54′	2° 58′	3° 1′	3° 4′	3° 7′	3° 11′	3° 15′	3° 19′	3° 23′	3° 27′	3° 31′	3° 35′	3° 39′	3° 44′	3° 49′	3° 54′												
25	T	2° 22′	2° 23′	2° 26′	2° 28′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′	2° 46′	2° 49′	2° 53′	2° 56′	2° 59′	3° 3′	3° 7′	3° 10′	3° 14′													
	B	2° 43′	2° 46′	2° 49′	2° 52′	2° 56′	2° 58′	3° 1′	3° 4′	3° 8′	3° 12′	3° 16′	3° 20′	3° 24′	3° 28′	3° 32′	3° 36′	3° 40′	3° 45′													
26	T	2° 20′	2° 22′	2° 24′	2° 26′	2° 29′	2° 32′	2° 35′	2° 38′	2° 40′	2° 43′	2° 47′	2° 49′	2° 53′	2° 56′	3 °0′	3° 3′	3° 7′														
	B	2° 41′	2° 44′	2° 46′	2° 49′	2° 54′	2° 56′	2° 59′	3° 2′	3° 6′	3° 9′	3° 13′	3° 16′	3° 20′	3° 24′	3° 28′	3° 32′	3° 36′	3° 40′													
27	T	2° 19′	2° 19′	2° 22′	2° 24′	2° 27′	2° 30′	2° 33′	2° 36′	2° 38′	2° 41′	2° 44′	2° 47′	2° 50′	2° 53′	2° 57′	3° 0′															
	B	2° 39′	2° 42′	2° 44′	2° 47′	2° 51′	2° 53′	2° 57′	3° 0′	3° 3′	3° 6′	3° 10′	3° 13′	3° 17′	3° 20′	3° 24′	3° 28′															
28	T	2° 17′	2° 18′	2° 21′	2° 23′	2° 26′	2° 28′	2° 31′	2° 33′	2° 36′	2° 39′	2° 42′	2° 44′	2° 47′	2° 51′	2° 53′																
	B	2° 37′	2° 40′	2° 43′	2° 45′	2° 49′	2° 51′	2° 54′	2° 58′	3° 0′	3° 3′	3° 7′	3° 10′	3° 14′	3° 17′	3° 21′																
29	T	2° 16′	2° 17′	2° 19′	2° 22′	2° 24′	2° 26′	2° 29′	2° 31′	2° 34′	2° 37′	2° 39′	2° 42′	2° 44′	2° 47′																	
	B	2° 36′	2° 38′	2° 41′	2° 44′	2° 47′	2° 49′	2° 52′	2° 54′	2° 57′	3° 1′	3° 5′	3° 7′	3° 10′	3° 14′																	
30	T	2° 14′	2° 15′	2° 17′	2° 19′	2° 22′	2° 24′	2° 27′	2° 29′	2° 32′	2° 34′	2° 36′	2° 39′	2° 42′																		
	B	2° 34′	2° 36′	2° 39′	2° 42′	2° 44′	2° 46′	2° 49′	2° 52′	2° 55′	2° 58′	3° 1′	3° 4′	3° 7′																		
31	T	2° 13′	2° 13′	2° 16′	2° 18′	2° 20′	2° 22′	2° 24′	2° 27′	2° 29′	2° 32′	2° 34′	2° 37′																			
	B	2° 32′	2° 34′	2° 37′	2° 39′	2° 42′	2° 44′	2° 47′	2° 50′	2° 53′	2° 56′	2° 58′	3° 1′																			
32	T	2° 11′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 23′	2° 25′	2° 27′	2° 29′	2° 32′																				
	B	2° 31′	2° 33′	2° 35′	2° 37′	2° 40′	2° 43′	2° 45′	2° 48′	2° 51′	2° 53′	2° 56′																				
33	T	2° 10′	2° 11′	2° 12′	2° 14′	2° 16′	2° 18′	2° 21′	2° 23′	2° 25′	2° 27′																					
	B	2° 29′	2° 31′	2° 33′	2° 36′	2° 38′	2° 40′	2° 42′	2° 45′	2° 48′	2° 51′																					
34	T	2° 9′	2° 8′	2° 11′	2° 12′	2° 14′	2° 17′	2° 18′	2° 21′	2° 23′																						
	B	2° 27′	2° 29′	2° 31′	2° 34′	2° 36′	2° 37′	2° 40′	2° 42′	2° 45′																						
35	T	2° 7′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′																							
	B	2° 25′	2° 27′	2° 30′	2° 32′	2° 34′	2° 35′	2° 38′	2° 40′																							
36	T	2° 6′	2° 6′	2° 8′	2° 9′	2° 11′	2° 13′	2° 15′																								
	B	2° 24′	2° 26′	2° 28′	2° 30′	2° 32′	2° 34′	2° 36′																								
37	T	2° 5′	2° 4′	2° 6′	2° 8′	2° 9′	2° 12′																									
	B	2° 22′	2° 24′	2° 26′	2° 28′	2° 30′	2° 32′																									
38	T	2° 3′	2° 2′	2° 4′	2° 6′	2° 7′																										
	B	2° 20′	2° 22′	2° 24′	2° 25′	2° 27′																										
39	T	2° 1′	2° 1′	2° 3′	2° 5′																											
	B	2° 18′	2° 20′	2° 22′	2° 23′																											
40	T	1° 59′	1° 59′	2° 1′																												
	B	2° 17′	2° 18′	2° 20′																												
41	T	1° 58′	1° 58′																													
	B	2° 15′	2° 16′																													
42	T	1° 57′																														
	B	2° 13′																														



TOP AND BASE ANGLES FOR BEVEL GEARS. ANGLE BETWEEN AXES 90°, TOOL PROPORTIONS BROWN & SHARPE STANDARD.

By F. Withers.

Number of Teeth in Wheel.

		72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43
12	T.	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 45′	1° 46′	1° 48′	1° 50′	1° 51′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 11′	2° 15′	2° 16′	2° 19′	2° 21′	2° 24′	2° 27′	2° 30′	2° 34′
	B.	1° 49′	1° 50′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 19′	2° 21′	2° 24′	2° 26′	2° 29′	2° 32′	2° 35′	2° 38′	2° 41′	2° 44′	2° 47′	2° 51′	2° 54′	2° 58′
13	T.	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 44′	1° 46′	1° 48′	1° 50′	1° 51′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 5′	2° 8′	2° 10′	2° 14′	2° 15′	2° 18′	2° 21′	2° 23′	2° 26′	2° 30′	2° 33′
	B.	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 5′	2° 7′	2° 9′	2° 12′	2° 14′	2° 16′	2° 18′	2° 21′	2° 23′	2° 25′	2° 28′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′	2° 46′	2° 50′	2° 53′	2° 57′
14	T.	1° 34′	1° 35′	1° 37′	1° 38′	1° 39′	1° 41′	1° 43′	1° 44′	1° 45′	1° 47′	1° 50′	1° 50′	1° 52′	1° 54′	1° 55′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 7′	2° 10′	2° 13′	2° 15′	2° 17′	2° 20′	2° 23′	2° 27′	2° 30′	2° 34′
	B.	1° 48′	1° 50′	1° 51′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 18′	2° 20′	2° 22′	2° 25′	2° 28′	2° 30′	2° 33′	2° 36′	2° 39′	2° 42′	2° 45′	2° 49′	2° 52′	2° 56′
15	T.	1° 34′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 42′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 51′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 3′	2° 5′	2° 8′	2° 11′	2° 13′	2° 15′	2° 18′	2° 20′	2° 22′	2° 25′	2° 28′	2° 30′	2° 33′
	B.	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 0′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′	2° 24′	2° 27′	2° 29′	2° 32′	2° 35′	2° 38′	2° 41′	2° 44′	2° 48′	2° 52′	2° 56′
16	T.	1° 33′	1° 35′	1° 36′	1° 37′	1° 38′	1° 40′	1° 42′	1° 43′	1° 45′	1° 46′	1° 48′	1° 50′	1° 51′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′	2° 24′	2° 27′	2° 29′
	B.	1° 47′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′	2° 27′	2° 30′	2° 32′	2° 35′	2° 38′	2° 41′	2° 44′	2° 48′	2° 52′
17	T.	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 45′	1° 45′	1° 48′	1° 50′	1° 50′	1° 53′	1° 54′	1° 56′	1° 57′	2° 0′	2° 1′	2° 3′	2° 5′	2° 8′	2° 10′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′	2° 24′	2° 26′	2° 28′
	B.	1° 47′	1° 49′	1° 50′	1° 51′	1° 53′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 17′	2° 19′	2° 21′	2° 23′	2° 26′	2° 28′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′	2° 46′	2° 50′	2° 53′
18	T.	1° 33′	1° 34′	1° 35′	1° 35′	1° 37′	1° 38′	1° 39′	1° 41′	1° 42′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 23′
	B.	1° 47′	1° 49′	1° 50′	1° 51′	1° 53′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′	2° 27′	2° 30′	2° 33′	2° 36′	2° 39′	2° 42′	2° 45′	2° 49′	2° 52′
19	T.	1° 33′	1° 34′	1° 35′	1° 36′	1° 37′	1° 39′	1° 40′	1° 42′	1° 43′	1° 45′	1° 47′	1° 48′	1° 50′	1° 52′	1° 54′	1° 55′	1° 56′	1° 59′	2° 0′	2° 3′	2° 5′	2° 7′	2° 9′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′
	B.	1° 47′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 1′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 23′	2° 25′	2° 28′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′	2° 46′	2° 49′
20	T.	1° 32′	1° 33′	1′ 34°	1° 36′	1° 37′	1° 38′	1° 40′	1° 41′	1° 42′	1° 45′	1° 46′	1° 48′	1° 49′	1° 51′	1° 53′	1° 54′	1° 55′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 7′	2° 10′	2° 12′	2° 14′	2° 16′	2° 19′	2° 21′	2° 23′
	B.	1° 46′	1° 48′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 19′	2° 21′	2° 23′	2° 25′	2° 28′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′	2° 46′	2° 49′
21	T.	1° 32′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 42′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 9′	2° 11′	2° 13′	2° 15′	2° 18′	2° 20′	2° 23′
	B.	1° 46′	1° 47′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 22′	2° 24′	2° 26′	2° 29′	2° 31′	2° 34′	2° 37′	2° 39′	2° 43′	2° 46′
22	T.	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 42′	1° 44′	1° 45′	1° 47′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 22′
	B.	1° 46′	1° 47′	1° 48′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 1′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 21′	2° 23′	2° 25′	2° 28′	2° 30′	2° 33′	2° 36′	2° 39′	2° 42′	2° 45′
23	T.	1° 31′	1° 33′	1° 33′	1° 35′	1° 36′	1° 37′	1° 39′	1° 40′	1° 41′	1° 43′	1° 45′	1° 46′	1° 48′	1° 50′	1° 50′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 0′	2° 3′	2° 4′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 20′
	B.	1° 45′	1° 46′	1° 48′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 4′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 20′	2° 22′	2° 24′	2° 26′	2° 29′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′
24	T.	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 39′	1° 41′	1° 42′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 15′	2° 17′	2° 20′
	B.	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 20′	2° 22′	2° 24′	2° 26′	2° 29′	2° 31′	2° 34′	2° 37′	2° 40′	2° 43′
25	T.	1° 30′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 42′	1° 43′	1° 45′	1° 46′	1° 48′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 1′	2° 2′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 18′
	B.	1° 44′	1° 45′	1° 47′	1° 48′	1° 50′	1° 51′	1° 52′	1° 54′	1° 56′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 24′	2° 27′	2° 29′	2° 32′	2° 34′	2° 37′	2° 40′
26	T.	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 51′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 1′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 17′
	B.	1° 44′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 1′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′	2° 23′	2° 26′	2° 28′	2° 30′	2° 32′	2° 35′	2° 38′
27	T.	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 39′	1° 40′	1° 42′	1° 43′	1° 45′	1° 46′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 16′
	B.	1° 44′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 1′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′	2° 27′	2° 29′	2° 32′	2° 35′	2° 38′
28	T.	1° 29′	1° 30′	1° 31′	1° 33′	1° 33′	1° 35′	1° 36′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 47′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 15′
	B.	1° 43′	1° 44′	1° 45′	1° 46′	1° 48′	1° 49′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′	2° 24′	2° 26′	2° 28′	2° 30′	2° 33′	2° 36′
29	T.	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 42′	1° 44′	1° 45′	1° 46′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 58′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 13′	2° 15′
	B.	1° 42′	1° 43′	1° 45′	1° 46′	1° 47′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 1′	2° 3′	2° 4′	2° 6′	2° 8′	2° 10′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 22′	2° 24′	2° 26′	2° 28′	2° 31′	2° 34′
30	T.	1° 28′	1° 29′	1° 30′	1° 32′	1° 33′	1° 34′	1° 35′	1° 35′	1° 37′	1° 38′	1° 40′	1° 41′	1° 43′	1° 45′	1° 46′	1° 48′	1° 50′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 1′	2° 3′	2° 5′	2° 7′	2° 9′	2° 11′	2° 13′
	B.	1° 42′	1° 42′	1° 44′	1° 45′	1° 47′	1° 48′	1° 50′	1° 51′	1° 53′	1′ 54°	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 3′	2° 5′	2° 7′	2° 9′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′	2° 27′	2° 30′	2° 32′
31	T.	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 35′	1° 35′	1° 37′	1° 38′	1° 40′	1° 40′	1° 42′	1° 44′	1° 44′	1° 46′	1° 48′	1° 50′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 8′	2° 11′
	B.	1° 41′	1° 42′	1° 44′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 1′	2° 2′	2° 4′	2° 6′	2° 8′	2° 10′	2° 12′	2° 13′	2° 15′	2° 17′	2° 19′	2° 20′	2° 22′	2° 24′	2° 27′	2° 30′
32	T.	1° 27′	1° 28′	1° 30′	1° 30′	1° 32′	1° 33′	1° 34′	1° 34′	1° 36′	1° 38′	1° 39′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 46′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′	1° 55′	1° 57′	1° 58′	1° 59′	2° 0′	2° 2′	2° 4′	2° 7′
	B.	1° 41′	1° 42′	1° 43′	1° 44′	1° 45′	1° 47′	1° 48′	1° 50′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 1′	2° 2′	2° 4′	2° 6′	2° 7′	2° 9′	2° 11′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 25′	2° 28′
33	T.	1° 27′	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 40′	1° 40′	1° 42′	1° 43′	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′
	B.	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 0′	2° 2′	2° 3′	2° 5′	2° 7′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′	2° 24′	2° 27′
34	T.	1° 26′	1° 27′	1° 29′	1° 30′	1° 30′	1° 32′	1° 33′	1° 33′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 44′	1° 45′	1° 47′	1° 48′	1° 50′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 59′	2° 0′	2° 2′	2° 4′	2° 5
	B.	1° 40′	1° 41′	1° 42′	1° 43′	1° 45′	1° 46′	1° 47′	1° 48′	1° 50′	1° 51′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 0′	2° 2′	2° 4′	2° 6′	2° 7′	2° 9′	2° 11′	2° 13′	2° 15′	2° 17′	2° 18′	2° 20′	2° 22′
35	T.	1° 26′	1° 27′	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 35′	1° 35′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	1° 43′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	2° 0′	2° 2′	2° 5′
	B.	1° 39′	1° 40′	1° 42′	1° 43′	1° 44′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′	1° 57′	1° 58′	2° 0′	2° 1′	2° 3′	2° 5′	2° 6′	2° 8′	2° 10′	2° 11′	2° 13′	2° 15′	2° 17′	2° 19′	2° 21′
36	T.	1° 25′	1° 26′	1° 28′	1° 28′	1° 30′	1° 30′	1° 32′	1° 32′	1° 34′	1° 35′	1° 36′	1° 37′	1° 38′	1° 40′	1° 40′	1° 42′	1° 44′	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 52′	1° 53′	1° 54′	1° 56′	1° 57′	1° 58′	2° 0′	2° 2′
	B.	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 44′	1° 46′	1° 47′	1° 48′	1° 49′	1° 51′	1° 52′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2° 0′	2° 2′	2° 3′	2° 4′	2° 6′	2° 7′	2° 9′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′
37	T.	1° 25′	1° 26′	1° 27′	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 38′	1° 39′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′
	B.	1° 38′	1° 39′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 46′	1° 47′	1° 48′	1° 50′	1° 51′	1° 53′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 2′	2° 3′	2° 5′	2° 7′	2° 8′	2° 10′	2° 12′	2° 14′	2° 16′	2° 18′	2° 20′	2° 22′
38	T.	1° 24′	1° 25′	1° 26′	1° 27′	1° 28′	1° 30′	1° 30′	1° 31′	1° 32′	1° 33′	1° 35′	1° 35′	1° 37′	1° 38′	1° 39′	1° 40′	1° 42′	1° 43′	1° 44′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 51′	1° 53′	1° 55′	1° 57′	1° 58′	2° 0′
	B.	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 52′	1° 53′	1° 55′	1° 56′	1° 57′	1° 58′	2° 0′	2° 2′	2° 3′	2° 5′	2° 6′	2° 8′	2° 9′	2° 11′	2° 13′	2° 15′	2° 16′	2° 18′
39	T.	1° 24′	1° 25′	1° 25′	1° 27′	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 37′	1° 38′	1° 39′	1° 41′	1° 42′	1° 43′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′	1° 57′
	B.	1° 38′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 44′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 52′	1° 53′	1° 54′	1° 56′	1° 57′	1° 58′	2° 0′	2° 2′	2° 3′	2° 5′	2° 6′	2° 8′	2° 9′	2° 11′	2° 13′	2° 14′	2° 16′	2° 18′
40	T.	1° 23′	1° 24′	1° 25′	1° 26′	1° 27′	1° 28′	1° 30′	1° 31′	1° 32′	1° 33′	1° 33′	1° 34′	1° 35′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′
	B.	1° 37′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 44′	1° 45′	1° 46′	1° 48′	1° 49′	1° 50′	1° 51′	1° 52′	1° 53′	1° 55′	1° 56′	1° 58′	1° 59′	2° 0′	2° 2′	2° 3′	2° 5′	2° 6′	2° 8′	2° 9′	2° 11′	2° 12′	2° 14′
41	T.	1° 23′	1° 24′	1° 25′	1° 26′	1° 26′	1° 27′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 36′	1° 38	1° 39′	1° 40′	1° 41′	1° 42′	1° 44′	1° 45′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 52′	1° 53′	1° 54′
	B.	1° 36′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 44′	1° 45′	1° 47′	1° 48′	1° 49′	1° 50′	1° 51′	1° 52′	1° 54′	1° 55′	1° 57′	1° 58′	2° 0′	2° 1′	2° 3′	2° 4′	2° 6′	2° 7′	2° 9′	2° 11′	2° 12′	2° 14′
42	T.	1° 23′	1° 24′	1° 24′	1° 25′	1° 26′	1° 27′	1° 28′	1° 29′	1° 30′	1° 31′	1° 32′	1° 33′	1° 34′	1° 35′	1° 36′	1° 36′	1° 38	1° 39′	1° 40′	1° 41′	1° 43′	1° 44′	1° 45′	1° 46′	1° 47′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′
	B.	1° 35′	1° 36′	1° 37′	1° 38′	1° 39′	1° 40′	1° 41′	1° 42′	1° 43′	1° 44′	1° 46′	1° 47′	1° 48′	1° 49′	1° 50′	1° 51′	1° 53′	1° 54′	1° 56′	1° 57′	1° 59′	2 0′	2° 1′	2° 2′	2° 4′	2° 5′	2° 7′	2° 8′	2° 10′	2° 11′

TOP AND BASE ANGLES FOR BEVEL GEARS. ANGLE BETWEEN AXES 90°, TOOL PROPORTIONS BROWN & SHARPE STANDARD.

By F. Withers.

Number of Teeth in Pinion.

LETTERS · FROM · PRACTICAL · MEN

Concerning the Details of making things in machine shops, from the first sketch to the sale

Toolmaker's Faceplate

The faceplate herewith shown in assembled views and details, can be used by the toolmaker in boring holes in small jigs, etc., that have usually been strapped on the regular lathe faceplate. The trouble of getting a hole to run perfectly true, in consequence of using the ordinary plate, is done away with in this design because the work on the faceplate is trued up not by "lead hammer adjustment" but by the more scientific manner of adjusting screws.

As the faceplate is made limited in adjustment, the work is clamped approximately central with the hole or the button on the jig, and the amount the work is out of true is noted by an indicator and proper adjustments can, therefore, be made.

The faceplate has adjustment two ways, at right angles with each other, and has four screws that securely lock the adjustable members as well as indicate in thousandths the eccentricity.

Fig. 1 shows the assembled device; Fig. 2, the part that is screwed on the nose of the spindle. The faceplate proper is illustrated by Fig. 3 and the middle part or slide by Fig. 4. Fig. 5 shows one of the adjusting screws with graduated collar under the head and Fig. 6 the two gibs.

Boston, Mass. D. E. RICE.

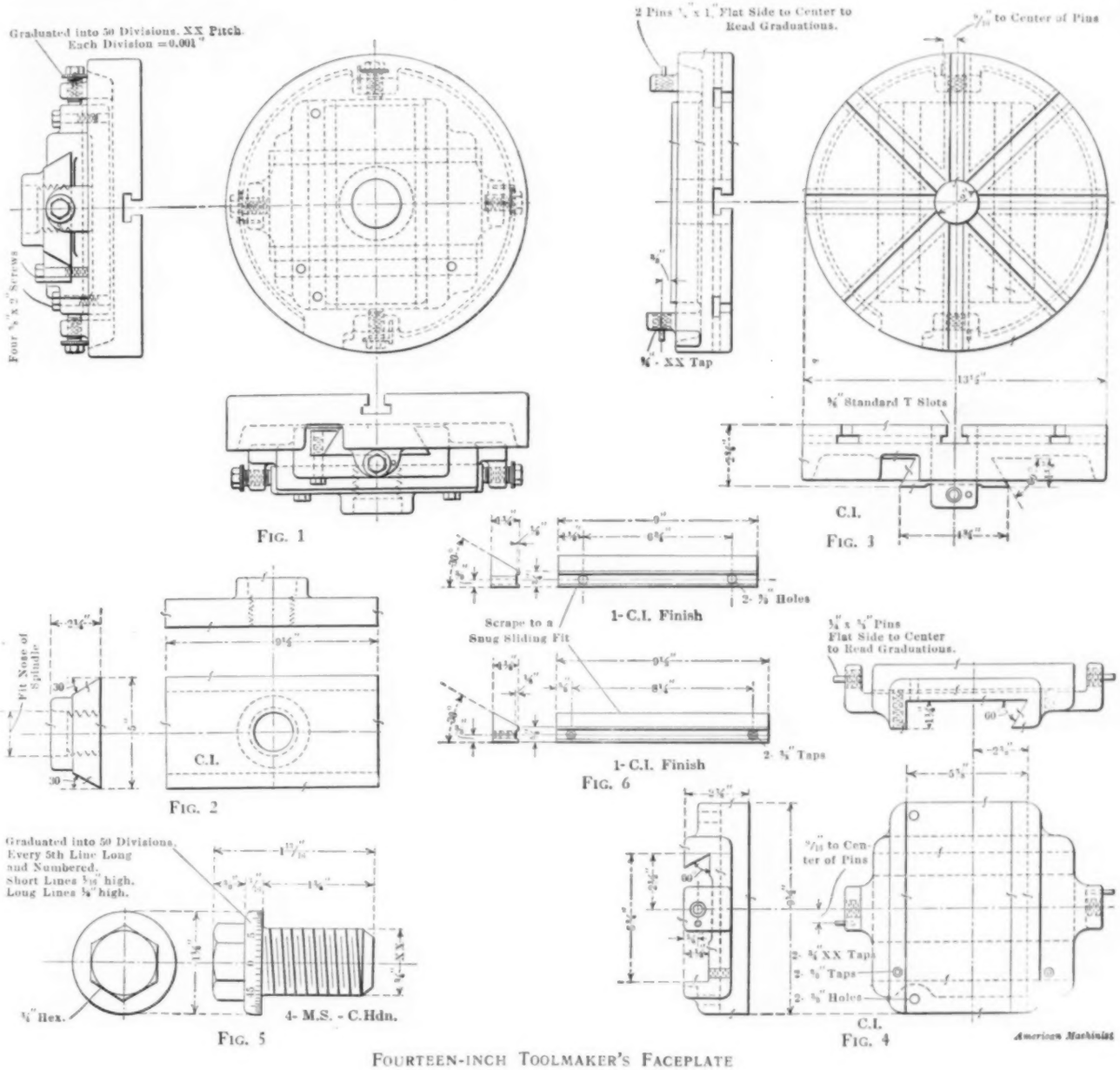

Graduated into 50 Divisions. XX Pitch. Each Division =0.001"
Four ⅜" x 2" Screws
2 Pins ⅜" x 1" Flat Side to Center to Read Graduations.
⅝" to Center of Pins
⅜" - XX Tap
13½"
⅝" Standard T Slots
C.I.
Fit Nose of Spindle
C.I.
1- C.I. Finish
2- ⅜" Holes
Scrape to a Snug Sliding Fit
1- C.I. Finish
2- ⅜" Taps
¾" x ⅜" Pins Flat Side to Center to Read Graduations.
Graduated into 50 Divisions. Every 5th Line Long and Numbered. Short Lines 5/16" high. Long Lines ¾" high.
¾" Hex.
4- M.S. - C.Hdn.
⅝" to Center of Pins
2- ¾" XX Taps
2- ⅝" Taps
2- ⅜" Holes
C.I.
American Machinist

FIG. 1 FIG. 3 FIG. 2 FIG. 6 FIG. 5 FIG. 4

FOURTEEN-INCH TOOLMAKER'S FACEPLATE

A Recessing Tool for the Turret Lathe

The sketches herewith show a recessing tool for the turret lathe, which is entirely different from any device I have seen described. It is much cheaper made than the majority of recessing tools and tool holders, while it is very efficient in its action.

Referring to Fig. 1, which is a plan of a turret lathe with the tool holder fitted in the turret, *A* is a bent steel bar, also shown in elevation in Fig. 2, made of rectangular stock 1⅛ to 2¼ inches wide and 5/16 to ½ inch thick, according to the size of lathe it is intended to use the device on. *B* is a turned steel disk about 3 inches in diameter by ½ inch thick, with a boss on the bottom, as shown in Fig. 2, which is turned eccentric with the periphery of *B*, and has a hole bored through it to secure it to *A* by the nut and bolt *D*. *C* is a small handle secured in *B*, as shown in Fig. 3.

This part of the device is attached to the headstock, with a cap screw passing through a slotted hole in *A*, as shown in Fig. 1. *E* is a malleable casting, also shown in plan and end elevation in Fig. 4, which forms the body of the tool holder. It has a slot milled across the face, in which is fitted a swiveling steel block *F* which is pivoted by the pin *G*. This block is shaped off at the back end, as shown at *K*. *H* is bored out to take the recessing tool, which is secured by the set screw *I*. The shank is bored out for a spiral spring which is passed up the inside, the back end being looped on to a steel pin *L*, which is driven tight into a small hole drilled through the sides of the hollow shank; the opposite end of the spring is secured to a small hook screwed into the block *F*, and keeps the lathes securely in position in the jaws *E*.

In operation, the turret is fed up to the stop in the ordinary manner, and the bar *A* adjusted endwise to suit the distance from *F*. When the cutting tool is in the correct position for recessing, the operator pulls the handle *C* around in the direction indicated by the arrow in Fig. 1, the cam action of *B* depresses *F*, and causes the cutting tool to describe a small arc toward the operator and recess the work in hand; immediately the handle *C* is released, the spring in the hollow shank pulls the block *F*, carrying the cutting tool back into position again. The cam and lever action is much quicker than a screw, and also much cheaper to make in this case, and quite as reliable and efficient.

London, England. J. W. ELLISSON.

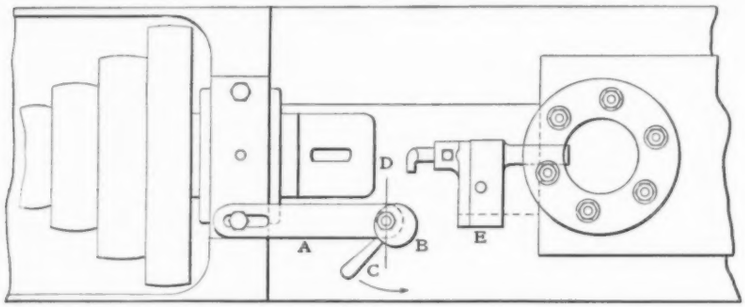


FIG. 1

FIG. 2

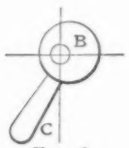
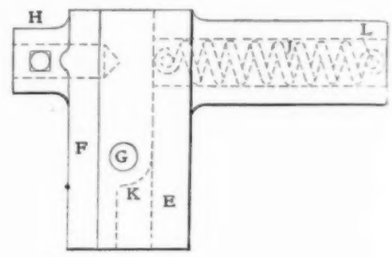


FIG. 3

A RESETTING TOOL FOR THE TURRET LATHE

A Vertical Milling Attachment for Tool Work

The sketch shows a vertical milling attachment for dies or other work such as milling small keyways, oblong holes, etc



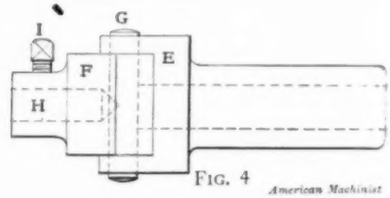


FIG. 4

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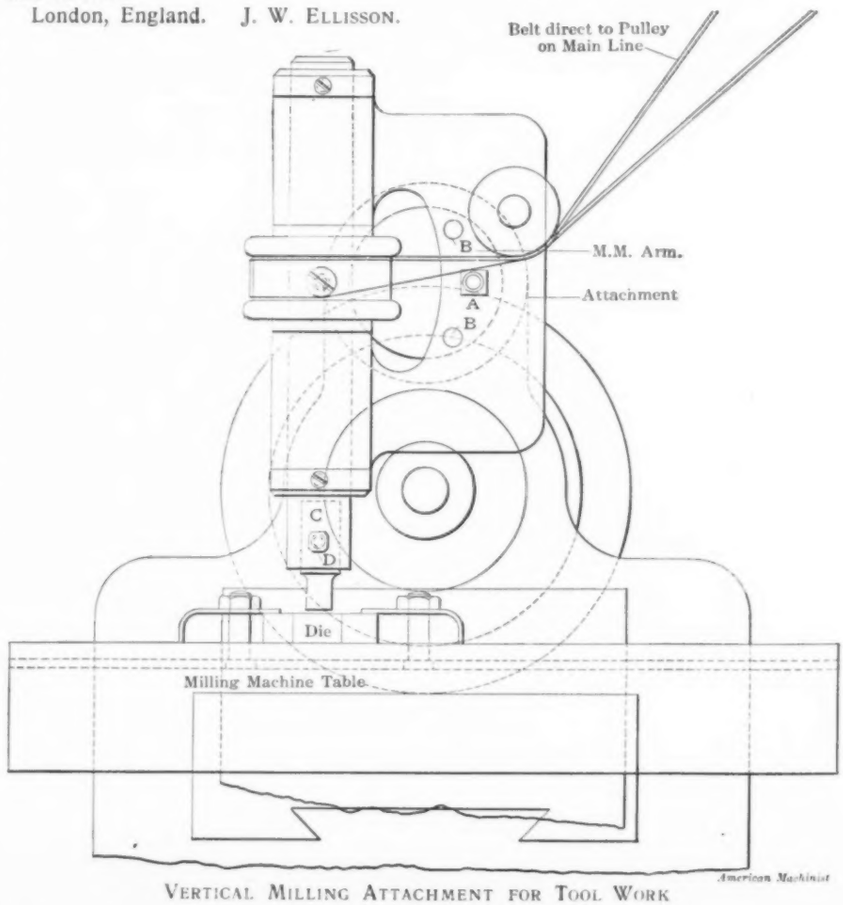
We were employed in a jobbing shop and, having considerable of that class of work to do, found it a very slow process and also quite expensive to chip and file this work. So we rigged up our little vertical attachment as shown by the sketch, which afterward proved a use-



VERTICAL MILLING ATTACHMENT FOR TOOL WORK

ful tool which was cheap and, therefore, highly prized by the boss.

The arm attached to the regular miller was taken out and turned around end for end and the vertical attachment bolted to it at *A* and secured by two dowel pins at *B B*. The power for driving the spindle was taken by belting direct from the line shaft as indicated. By loosening the arm the device could be swung to any angle desired. For holding end mills a straight standard-size hole was bored in the spindle at *C* and the mill held by a small set screw *D*. It will be noticed that the die is shown held by small clamps, but considerable work was done by means of the vise.

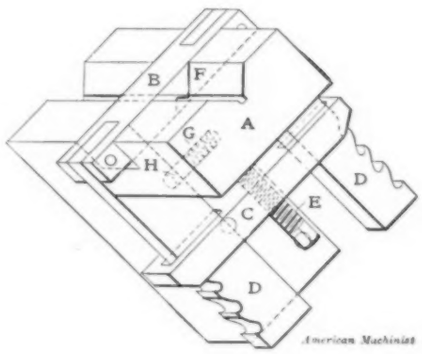
We used this tool for quite a while, and then made an improved one with hardened and ground spindle and bronze bushings.

Philadelphia, Penn. C. & D.

Combined Angle Plate and V-Block

This device I designed and built for use in my work of die making. The new feature about the tool is the arrangement by which a short screw is used. This short screw will clamp all the different sizes which the tool can take in, that is, from ½-inch up to 4-inch, round or square stock.

A is the body of the tool proper; *B* is the clamping bar into which a V is cut to correspond with *F* (the V in the body) and it can be moved forward or back according to requirements. *D D* are side bars into which are cut a certain number



COMBINED ANGLE PLATE AND V-BLOCK

of teeth which catch the ends of the binding bar *C* and when the screw *E* is set up against the body *A* and forces the bar *C* backward, bar *B* is pulled back and clamps the work. To move bar *B* forward take parts *D D* between the thumb and forefinger and press them together; this releases binding bar *C* and allows it to be pulled backward and then bar *B* can be pulled forward so as to admit the stock. *G* is a coil spring and *H* is a pin set in the body *A* on each side to force rods *D* apart so that they catch on the ends of binding bar *C*; then a few turns of screw *E* will clamp the work solidly. This appliance can be clamped on the table of a drill press or on the face plate of a lathe or grinding machine.

Montreal, Canada. G. A. BEAUDRY.

Finding the Radius of Work

Mechanics in the various trades often find it necessary to obtain the radius and irregular outlines of parts of machinery and patterns, many times making templets necessary. Such templets, even when wood or cardboard, take a great deal of time to make; many times it is inconvenient to get at the work, and one has rarely ever such material at hand, and it is generally too bulky to

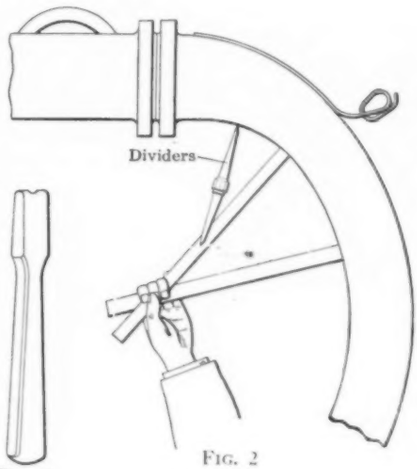


FIG. 1 FIG. 2

FIG. 3 American Machinist

FINDING THE RADIUS OF WORK

carry along. For tool, punch and die work, metal templets are, of course, necessary, but for work that does not require such accuracy, I have a method which I have been using with the best of satisfaction, and it may be of benefit to many readers of the AMERICAN MACHINIST.

I use a piece of ⅛-inch soft solder wire and a stick of wood as shown in Fig. 1. Before forming the wire to the work be sure to straighten out the small kinks that may be in the wire from previous use. Then lay the wire to the work and bend it to shape with the end of stick, Fig. 1. When well formed so that the wire rests evenly on the work, lay the wire on a board and with one point of a pair of dividers resting on the board, adjust the dividers until the other point follows the side of the wire formed to the work.

Fig. 2 illustrates a locomotive steam pipe which has many different radii and irregular shapes to be followed in making a new pipe. I have sketched pipes on the engine without taking them down. Also a very convenient way to find a radius on the inside where one can get at it, is to take two pieces of wood as shown, hold with one hand to steady them and adjust the dividers with the other, resting one point on the piece of wood as in Fig. 2, and adjusting until the correct radius is found.

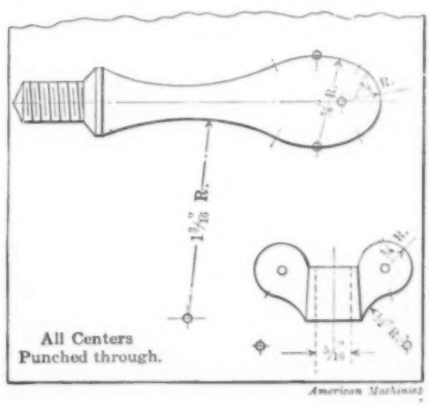
Fig. 3 shows the wire used to get the radius on the cross-section of the pipe which usually varies from end to end.

Chicago, Ill. C. V. FRISK.

Drawing Board Templets for Laying Out Details

The accompanying sketch shows one of a set of celluloid templets which will be found great time savers in drawing small machine details such as thumb nuts and screws, ball handles, clamping knobs for tools and fixtures, and many others.

The illustration shows this idea applied to two of the above. The templet is made from a piece of transparent celluloid about 0.01 inch thick, and large enough to contain the outlines of the several standard sizes used. The outline of the piece and the radii required are first scratched on the celluloid with the dividers, and the centers of the different circles punched clear through; then the scratches are filled with india ink, giving clear and permanent lines.



CELLULOID TEMPLET FOR STANDARD PARTS

In using this device the draftsman has simply to lay the templet over the spot on the drawing where it is desired to locate the handle or other detail, pick the size most suitable for the purpose, prick the centers for the circles through onto the drawing and setting his compasses to the radii given, draw the piece in half the time usually required.

T. J. S. KISHPAUGH.

Harrisburg, Penn.

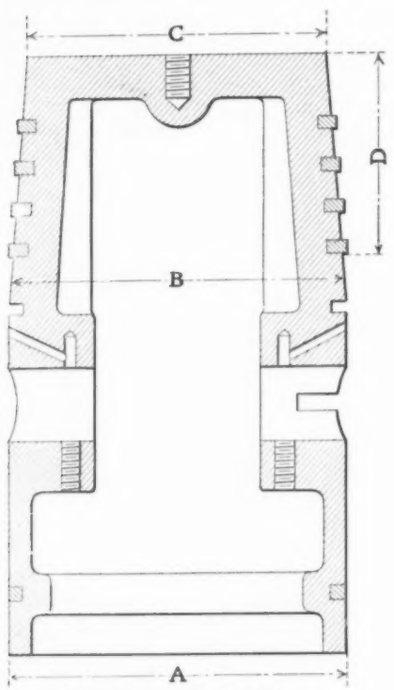
? DISCUSSION of the PREVIOUS QUESTION ?

Letters from our Readers showing how many Men of many Minds look upon Various Subjects Opened up in previous Numbers

Grinding Large Cylinders, Pistons and Rings—Piston Clearance

On page 898, Volume 32, Part 2, the questions of grinding cylinders and piston clearances required, are discussed. As these are matters that are of interest to many of your readers, I have pleasure in giving you the following particulars from my own experience.

Some seven years ago, I was with a large firm of steam-engine builders in the Midlands and the question was raised as to whether or not it would pay to finish cylinders by grinding. I may mention that we were boring these in the lathe, the cylinders being bolted to the faceplate. I sketched out a grinding attachment for fixing on the studs of the tool rest and bolted a 1-horsepower motor on the back of the slide for driving the emery-wheel spindle. The wheel was 4 inches diameter by 1½ inches wide. This resulted in a much better finish and reduced finishing time 50 per cent. We ground cylinders up to 36 inches bore with this rig. I have since introduced this method of finishing into two other engine shops with equal success.



Note:- Taper of Portion D is shown exaggerated. *American Machinist*

DIMENSION DIAGRAM OF PISTON FOR SINGLE-ACTING VERTICAL GAS ENGINE

I have ground gas-engine pistons up to 48 inches diameter in the ordinary lathes, by bolting a small motor on the rest, with the emery wheel on the outer end of the motor spindle. The saving in time alone is worth the expense of an outfit of this kind, apart from the superior finish obtained by grinding. Again, when a piston begins to seize in the cylinder, due to want of lubrication, too much load, or some other cause, the piston can be drawn and the "seize" ground out, where the lathe tool would not touch it on account of the hardness.

It is strange that grinding-machine makers have not done something to cater to this class of work. The largest shops in this country have all had to design their own special attachments. The only machine I know of for grinding large cylinders is made by a German firm, and its cost is prohibitive to the majority of engine builders. Anything in this line must be in the shape of an attachment either for the lathe saddle or to attach to the boring bar and must be self-contained.

For grinding piston rings, we had a machine made similar in appearance to the Bullard mill, only in place of the tool turret, we carried the emery-wheel bracket. The machine had a 48-inch magnetic chuck, and the rings were simply dropped on. The average output of this machine was about 18 per hour. This was for grinding faces only. After this they were sprung into a bush, a dozen or more gripped together by a screwed mandrel and ground on the outside diameter. The saving by grinding cylinders, pistons and rings is roughly 50 per cent. over the turning times.

The clearances of pistons in cylinders varies according to the kind of gas used and whether the piston is water cooled or not. The sketch and table herewith show the clearance for vertical gas engines running on producer gas. For horizontal gas engines, the clearances are as follows, for producer gas. For town gas add 25 per cent. to all these figures.

A and *B* = 0.00075 inch per inch diameter for pistons not water cooled,

A and *B* = 0.0005 inch per inch diameter for pistons water cooled.

C = 0.025 inch less than *A* and *B*.

The figures given have been obtained by practice and are reliable. The side clearance of rings is governed by the diameters. The usual allowance is: 5 to 10 inches diameter, —0.001 inch; 10 to 20 inches diameter, —0.0015 inch; 2 inches upward, —0.002 inch.

Size of Engine.	Cylinder Bore.	A	B	C	D
6″ x 8″	6″	0.002	0.002	0.016	
7″ x 8″	7″	0.003	0.003	0.017	
7″ x 9″	7″	0.003	0.003	0.017	
8″ x 9″	8″	0.003	0.003	0.018	
8″ x10″	8″	0.003	0.003	0.018	4⅞″
9″ x10″	9″	0.003	0.003	0.021	4⅞″
9″ x11″	9″	0.003	0.003	0.021	4⅞″
10½″x11″	10½″	0.004	0.004	0.026	4⅞″
11″ x12″	11″	0.004	0.004	0.028	5⅜″
13″ x12″	13″	0.004	0.004	0.035	5⅜″
12″ x14″	12″	0.004	0.004	0.032	6⅜″
13″ x14″	13″	0.005	0.005	0.035	6⅜″
14″ x14″	14″	0.005	0.005	0.040	6⅜″
15″ x14″	15″	0.006	0.006	0.045	6⅜″
13½″x16″	13½″	0.005	0.006	0.037	6⅞″
15½″x16″	15½″	0.006	0.006	0.047	6⅞″
14″ x18″	14″	0.005	0.005	0.040	7¾″
16″ x18″	16″	0.006	0.006	0.050	7¾″
16″ x20″	16″	0.007	0.007	0.050	7¾″
18″ x20″	18″	0.008	0.008	0.060	7¾″
18″ x22″	18″	0.009	0.009	0.060	9″
20″ x22″	20″	0.010	0.010	0.070	9″

The actual diameter of piston must be 0.00025 inch per inch diameter, less than cylinder bore, in addition to above allowances.
The above figures are net clearances.

With these parts all ground, greater care has to be taken, when starting up an engine, to see that the piston is being properly lubricated and the engine should be run light for a short time to allow the "skin surface" to begin to form. If not, a dangerous grip may be the result. Aside from this, grinding has everything in its favor. After three years running with one engine, we gaged the piston and cylinder lines (these having been ground) and found the wear not 25 per cent. of the amount of others of which we had records and which had been working under the same conditions. Other records taken since, also substantiate the above figure.

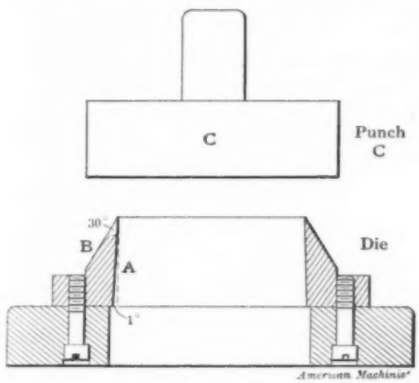
PRODUCER.

W. Nottingham, England.

Punching Fiber

On page 915, Part 2, Volume 32, of the AMERICAN MACHINIST, there are a few points which want elucidating. From my experience, I have never found the ordinary punch and die to work satisfactorily on fiber.

Mr. Dale has got on the right track but has not carried it out far enough.



PUNCH AND DIE FOR FIBER

I obtained the best result by giving the die one degree of taper at *A*; backing off face *B* 30 degrees to face *A* and then oilstoning to a knife edge. Punch *C* was a brass casting machined with a perfectly flat face, and as soon as there was any wear, the punch was taken out and trimmed up again. By this method we were able to produce a perfectly clear blank with one operation.

Birmingham, Eng. J. AYMES.

Producing Taper Holes in Sheet Steel

In answer to the question asked on page 744, Volume 32, Part 2, the manuacture of steel sheets perforated with taper holes is performed by different methods. If the requirements as to finish be rigorous, the sheet is first perforated with cylindrical holes, in an ordinary manner, and these are afterward

PUNCH FOR TAPERED HOLES IN SHEET STEEL

reamed out tapering on special drilling machines. Another method is far cheaper, however, in which the holes are at the same time punched and pressed tapering. The punches have the form shown herewith. By this method, however, it is necessary that the sheet be perforated across its whole width at the same time, which necessitates very powerful machines. If, as in the case presented, a stamp with only 9 punches is used, the sheet becomes much curved, since the tapered pressing greatly expands the material. All perforated sheets with taper holes must be straightened before further use, which is done on sheet straightening machines with five or seven rolls.

Barmen, Germany. RETLAW.

Deep Boring Job

On page 838, Part 2 of Volume 32 of the AMERICAN MACHINIST, M. J. W. asks how he can machine the holes in the spindle shown by Fig. 1. The part of the hole that is 3 15/16 inches diameter must be bored accurately for a tight-fitting bush to fit into. The depth of the 3 15/16-inch hole is not given, so I have fixed this dimension at 6 inches.

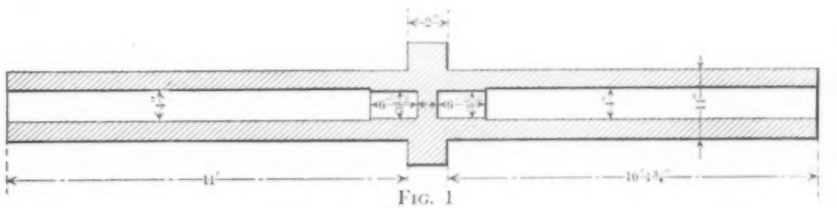


FIG. 1

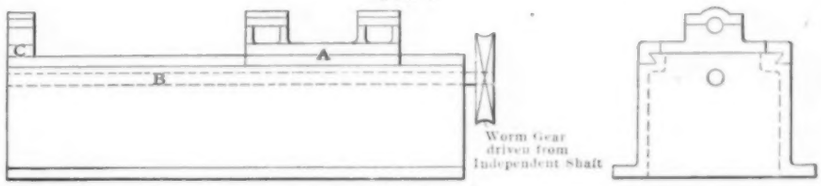


FIG. 2

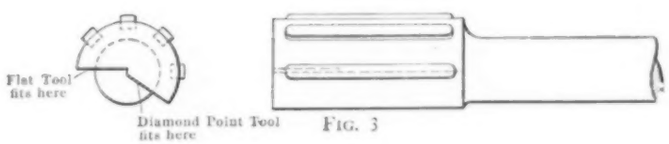


FIG. 3

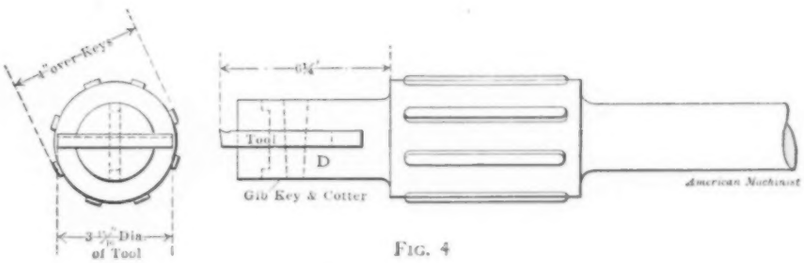


FIG. 4

DEEP BORING JOB

For this class of work a boring head similar to Fig. 2 is usually used. It is readily fixed to a lathe bed and is reliable. The boring bars are fixed in the saddle *A* which receives its motion from the screw *B*. The bracket *C* serves as a guide for the boring bars.

In Fig. 3 is shown the usual type of tool block. The loose keys are made a working fit to a standard ring gage of the diameter of hole to be bored. There are two tools employed; a diamond-pointed tool with two or three points to lead and break the cut, and a flat tool, equal to half the diameter of the hole to be bored, to take the full cut. Where each tool is bolted on is shown.

In Fig. 4 is shown a special tool block that is required to bore the 3 15/16-inch hole. It is fitted with loose keys and has an extension piece *D* to carry the tool. The tool is fitted in a slot and is secured in position by a gib key and cotter. The tool must be forged and fitted in the block before it is hardened and the block then put in the lathe and the tool turned to fit the 3 15/16-inch ring gage, as well as squared at the end. The necessary lip and clearance can then be filed on the square end and the tool hardened. It will be necessary after hardening to again fit the cutter to the ring gage, which can be done with emery. Boring blocks of this type should have water pumped on them to keep the tool cool and wash the cuttings out of the hole.

In machining the spindle it should first be rough turned all over about ¼ inch larger than the finished size. Then bearings should be shimmed up every 5 or 6 feet and the spindle runs on these when boring is in progress. The boring head

is next fixed in position and a 3⅞-inch hole is bored to within a finishing cut of the bottom of the hole. Then the end of each hole must be opened out to 4 inches diameter by about 5 or 6 inches deep; the four boring bars inserted and this hole bored out to its finished diameter and proper depth and then the special block, Fig. 4, inserted and the 3 15/16-inch hole bored and finished to the correct depth. Loose centers must now be fitted into the end of each hole, the spindle put into the lathe and set dead true by the bearing places, and the outside machined to size. An average speed for boring this class of work is from 4¼ to 6 inches per hour.

Darlington, Eng. SCOTTIE.

Comments on Industrial Training

Mr. Vose's article at page 916 interested me all the more because he not only touched on my favorite theme, but because he stated some wholesome truths about the reason for the present dearth of skilled mechanics here in the East. It is undeniably true that this country has been wasteful of its resources, not only timber and coal and iron but its men. We are only beginning to pay the penalty for what our forefathers for some generations back have done. They were as much to blame as we, for they were the ones that first sowed the seeds of discontent in our fathers' minds, which in turn led them to feel that learning a trade was beneath us; a feeling that I believe has passed its worst stage and is now rapidly changing.

Just a trifle of the fault may be with our technical colleges of a few years back. I remember that my father sent me to one of these places for the express purpose of learning the patternmaker's trade, because it was a cleaner trade than his! I do not think he ever got it clearly in his mind that I was not a skilled patternmaker when I graduated. Most of these schools represented at one time that they expected to teach trades. It is really only recently that they have flatly come out as graduating engineers only.

THE SALFORD INSTITUTE

In this connection I took especial interest in the calendar of the Royal Technical Institute of Salford, England, which Mr. Vose was kind enough to ask the editor of the AMERICAN MACHINIST to forward to me, presumably for comment.

A cut of the buildings shows a beautiful piece of architecture with ample, park-like grounds in front. The contrast with the well known shops of the Milwaukee school is great, though one can not but wonder if the Milwaukee school does not more nearly meet the shop spirit of which I have had so much to say. On the other hand there is no doubt that the Salford buildings would attract many more boys who might not have very positive ideas as to their futures. Some might say that it was wrong to induce a boy to take up a trade by surrounding him with advantages that he could never hope to find in his commercial life. On the contrary I feel that we have already done too little in that direction, not only with the boys but with the men themselves. There is no reason why a shop cannot be made a very attractive place for a man with mechanical aptitude, and I do believe that teaching a boy his trade under good surroundings is a good and safe step toward giving the man better accommodations.

Then again, are not we justified in sugaring a pill a trifle? A boy is not to be expected to have the same judgment regarding his life that a man has. A man may say, "I will take this job on small pay because it will lead to great things." A boy cannot be expected to look so far into the future that he will deliberately spend years in surroundings that are uncongenial for the sake of the hope that some time he may make a place for himself higher up than he might otherwise attain.

THE DAY CLASSES

The day classes are "intended to provide a connecting link in the educational scheme of the borough, by which pupils may be enabled to obtain a scientific and technical training before entering works or proceeding to the university." Which last idea, that the same training might lead either way, suggested that the head of the institution must be a Ph.D.; which I also note to be the case. It is just as hard for a university graduate to see why the two are not alike as for a hen to see why the chicken that she hatched out of a duck's egg likes water, and there is the same limit of resemblance between all four, the boy in the shop, the boy in the university, the duckling and the chicken—they each have two legs!

THE EVENING CLASSES

The evening classes apparently offer us more hope. "They are intended for those who are engaged in industrial or commercial occupations in the day time, and who desire to receive supplementary instruction in the application of science or art, to the trades and manufactures in which they are concerned!" There appears to be need of doing just this thing in this country. We have numberless men who do their work without the slightest suspicion of why they do it one way rather than another, men who move machinery without any knowledge of what chances they are taking or how they might use the power at their disposal to better advantage; men running our power plants who have no idea that there is a science under it all. Whether Salford is getting at these men in the right way I do not know but it is a field that we need to cultivate here, not by night courses in our ordinary day colleges, but by special instruction by men who spend their daytimes doing things.

Springfield, Mass. ENTROPY.

Coefficient of Friction—Metal on Wood

Referring to inquiry, page 169, coefficient of friction, "Nystrom's Mechanics" gives iron on lignumvitæ axles in motion, dry, slightly greasy or wet, 0.188; with oil or tallow, 0.125. Friction of plane surfaces, iron on oak in motion, tallow lubricant, 0.078.

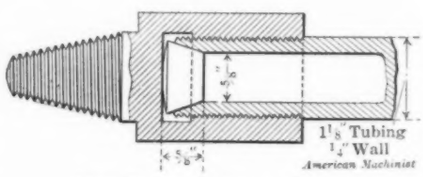
This would seem to imply that your correspondent is correct in his assumption that the coefficient is too high as stated above.

Date of issue of my copy is 1892; publishers, J. B. Lippincott Company. Over 5 years is not too old for a formula, many being ten times 5 and still holding good.

Erie, Penn. A. N. HAMMOND.

Those Expensive Taper Pins—Making Taper Plugs

In connection with Mr. Adams' suggestion at page 63 regarding taper pins I would like to say that we have made taper plugs in the same manner. They were used as expanders on hollow rods



THE TAPER PLUG IN PLACE

of a sounding drill as shown in the accompanying sketch. The plugs were originally to be turned, but the work being required in a hurry, we made the punchings of ⅝-inch plate and then bored the taper in the tubes to fit. The scheme worked very nicely and enabled us to make delivery on time.

Newark, N. J. ARTHUR LOWY.

Examples in Modern Grinding Practice

Mr. Tappan on page 961, Volume 32, Part 2, asks for further information as to the nature or properties of the "flat-ground pebble" used for glazing a grinding wheel to obtain a higher finish. No special qualities are required, for a piece of oil or india stone is often used for the same purpose of dulling or glazing the wheel. With regard to the danger of heat

arising in its application, this is of little account; for as stated in the article it must be applied very lightly to preserve the truth of the wheel. Mr. Tappan seems to have understood that the pebble is used for forming the radius on the wheel yet the article describes and illustrates the use of a fixture designed for this purpose in which the radius is formed with a diamond tool. H. DARBYSHIRE.

Coventry, Eng.

The Toggle Joint

On page 857, Volume 32, Part 2, of the AMERICAN MACHINIST an article on the toggle joint by H. Terhune states that

$$\frac{R}{P}=\frac{cos.\,a}{2\,sin.\,a},$$

where a is the angle between each strut and the horizontal base line. It is important to note that this holds only when the struts are of equal length.

Some readers may be interested to know how this formula is obtained, so I have worked it through from elementary principles.

Referring to Fig. 1, $A\,B$ and $A\,C$ represent the two struts. F acts along $P\,A$, and R acts along $C\,B$. Now at the point B there are three forces acting, which are in equilibrium. They are: the stress in $A\,B$; the reaction of the guide bar X and a force equal to R but opposite in direction. These three forces may be represented by the sides of a triangle taken in order, the sides being parallel to the forces.

In Fig. 2, $P\,Q$ represents the force F. $Q\,R$ is parallel to $B\,A$. $P\,R$ is parallel to $A\,C$. Then these last two lines represent the stresses in the struts.

As $R\,Q$ represents one force, the others are represented by $Q\,S$ and $R\,S$, that is, $R\,S$ represents the resultant force R in Fig. 1.

Now in any triangle

$$\frac{a}{sin.\,A}=\frac{b}{sin.\,B}=\frac{c}{sin.\,C}$$

where A, B and C are the angles, a, b and c the sides opposite, so

$$\frac{Q\,R}{sin.\,P}=\frac{P\,Q}{sin.\,P\,R\,Q}$$

$$\therefore\ \frac{Q\,R}{P\,Q}=\frac{sin.\,P}{sin.\,P\,R\,Q}.$$

And as $R\,S\,Q$ is a right angle,

$$R\,S=Q\,R\,cos.\,S\,R\,Q$$

or

$$Q\,R=\frac{R\,S}{cos.\,S\,R\,Q}$$

$$\therefore\ \frac{R\,S}{P\,Q}=\frac{sin.\,P}{sin.\,P\,R\,Q}\times cos.\,S\,R\,Q,$$

but

$$\frac{R\,S}{P\,Q}=\frac{R}{F}$$

and the angle $S\,R\,Q=B$

angle $P=90°-C$

angle $P\,R\,Q=180°-A$,

therefore

$$\frac{R}{F}=\frac{cos.\,C}{sin.\,A}\times cos.\,B. \qquad (1)$$

If the two struts are of unequal length, this is the formula which must be used, but if they are the same length it can be simplified somewhat.

Then

$$C=B,$$

and

$$sin.\,A=2\left(sin.\,\frac{A}{2}\,cos.\,\frac{A}{2}\right)=2\,cos.\,B\,sin.\,B$$

(as can be seen from Fig. 3)

so that

$$\frac{R}{F}=\frac{cos.\,B\,cos.\,B}{2\,cos.\,B\,sin\,B}$$

and

$$\frac{R}{F}=\frac{cos.\,B}{2\,sin.\,B}. \qquad (2)$$

This is the same as the formula originally spoken of.

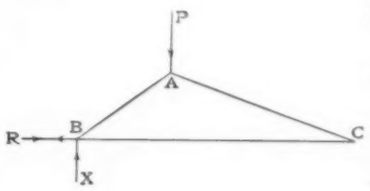


FIG. 1

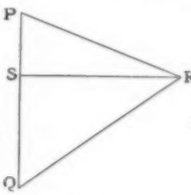


FIG. 2

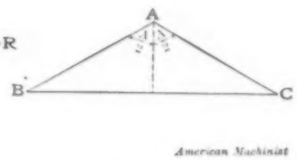


FIG. 3

THE FORCES ACTING IN A TOGGLE JOINT

From either formula it results that, when the toggle links are all the way down, the force R is infinite. For in (1) angles C and B will then be zero and their cosine unity, but angle A will be 180 degrees and its sine. will be zero. Then

$$R=F\times\frac{1\times 1}{0}$$

which is infinity.

In (2) *cos.* B becomes unity, but *sin.* B is zero, again giving an infinite force R. Of course, in practice, the give of the materials prevents the force from ever even approaching such a figure, but the argument goes to show that the actuating force F may be multiplied indefinitely in R, if only the materials have sufficient strength and rigidity.

London, England. FERNO.

On page 857, Volume 32, Part 2, there appears an article by H. Terhune about toggle joints. He there gives his opinion about various formulas he has found in text- and handbooks and especially mentions the formula he found in Kent, that is:

$$R:P::cos.\,a:2\,sin.\,a,$$

or

$$P=\frac{2\,R\,sin.\,a}{cos.\,a}.$$

It would be interesting to know how he found out that this formula was not correct. I rather think he has misunderstood its meaning, or else does not understand the problem at all, which latter I am more inclined to think, after reading his article through.

He has given the following formula

$$P=\frac{R\,(versed\,sin.\,a+versed\,sin.\,b)}{sin.\,a}$$

and as an explanation of how he got this formula he says "the force passing through a certain distance being equal to the resistance through a certain distance." This is not a true statement. The force is supposed to be constant and as the resistance is variable the force is equal to the resistance at some certain point, but never through a distance.

What he should have said is that the product of the force and the distance through which it acts is equal to the product of the resistance and the distance through which it acts. The resistance here would be the mean or average resistance. Mr. Terhune has, besides mechanics, also forgotten his trigonometry. Referring to his diagram, he says that $x=versed\,sin.\,a$ and $y=versed\,sin.\,b$. This would be true if both lever arms were equal to unity. As he states the problem the lever arms are not equal, and therefore, let us assume the lengths of same to be

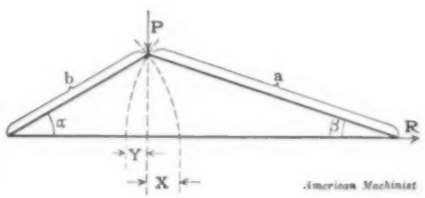


DIAGRAM OF TOGGLE

(a) and (b) respectively as shown in the accompanying diagram.

then

$$x=b-b\,cos.\,\alpha=b\,(1-cos.\,\alpha)=b\,versed\,sin.\,\alpha$$

and

$$y=a-a\,cos.\,\beta=a\,(1-cos.\,\beta)=a\,versed\,sin.\,\beta$$

$$\therefore\ P\times b\,sin.\,\alpha=R\,(x+y)=R\,(b\,versed\,sin.\,\alpha+a\,versed\,sin.\,\beta)$$

or

$$P=\frac{R\,(b\,versed\,sin.\,\alpha+a\times versed\,sin.\,\beta)}{b\times sin.\,\alpha}$$

which is the correct formula for the condition which he shows.

Brooklyn, N. Y. JOHN A. CARLSAN.

The Commercial Effect of Odors

At page 856, Volume 32, Part 2, W. Osborne in his "Echoes from the Oil Country," had an interesting article on the commercial effect of odors. As might have been expected, no one has arisen to criticize the article or refute Mr. Osborne's theories, the general verdict being that whatever Osborne says about odors "goes" because he lives in the Oil Country and he "knows."

One part of the article, wherein Mr. Osborne refers to the disagreeable odor attached to certain high-grade catalogs and other printed matter, recalls an incident in my experience.

In our shop an AMERICAN MACHINIST subscription club is formed each year and I am delegated to round up the subscribers. Although most of our men from the superintendent down take this or some other good technical magazine, there are in this shop, as in most others, a certain number of chronic nonreaders who seem to be quite beyond hope.

Many and varied are the excuses they offer when approached to subscribe. Some of these men, who do not see the paper from one year's end to another, consider the reading matter to be beyond their understanding. Others, chiefly apprentices, have reached a stage where their experience and ability render the reading of the paper unnecessary. One man has been consulting his wife about it for five years. Some few do not subscribe because, they confide to me annually, they have higher professions and are working as machinists only temporarily. Among these are a dentist, a plumber, two musicians, a politician and a man who expects to be put on the police force. For seven years one young fellow has threatened to leave the shop each succeeding week and accept a $200-per-week engagement in vaudeville. Otherwise he would surely subscribe. He is still at the drill press.

However, the most unique excuse of all, and the one I had in mind when I commenced this letter, was furnished by a certain machinist whom I thought really might subscribe: "I think the AMERICAN MACHINIST is the best magazine of its kind," he said, "and I'd like to take it but the fact is that such copies as I have ever read have had about them an odor, from the paper or ink, doubtless, which I can't describe, but which invariably made me sick." This excuse was so original and refreshing that I was about to congratulate him and offer him a free subscription as a Christmas present to reward his originality, when I realized the dire consequence to his health and changed my mind, doubtless saving his life thereby.

As the above incident actually occurred, Mr. Osborne may take it for what it is worth in support of his theories on the commercial effect of odors.

Allentown, Penn. ALLAN FORBES.

Heat Treating to Reduce Size of Hole

I note where H. D. Chapman gives a method which he terms is practical, for reducing a hole that has been bored or drilled too large, in a piece of tool or machine steel. I can hardly agree with him that his method is practical from the fact that it is liable to cause water checks in the work, if of tool steel.

When we place a bushing or any tool with a hole perpendicular to the surface of the water and dip the piece half way in, it will reduce the piece in size, but not to any great extent, and it is both unsafe and unreliable. It is much safer to heat the bushings, or the piece to be reduced, to the hardening heat (if machine steel, to 1472 degrees Fahrenheit), then place a piece of asbestos over each end, to prevent the water from entering the inside and submerge under the water entirely, holding there until vibration ceases, then remove. This is positive as the bushing or hole must close and become smaller from the fact that the steel has cooled on the outside first, staving up the inside which has been slow in cooling.

There is, of course, a drawback to this method if not executed properly. If the bushing is placed on a wet piece of asbestos it will become bell-mouthed, or if the piece is not clean when quenched, it will be out of round. It is therefore necessary to use precaution in doing the work or uniform results will not be secured. If the bushing or hole is too small and it cannot be reheated, or bored to the desired size, this can also be remedied by a similar process of treatment which is as follows: Turn a pin to the size desired; heat the bushing and slip over the pin and quench as if to shrink on; then reheat the piece together with the pin to a red heat, visible in the daylight. Next cool by placing pin and bushing in the water and drawing them out, repeating this until the piece is entirely cool. When the piece is cooled, the bushing will drop off and be the desired size.

I have also taken combination gage plugs 2½ inches in diameter that were under size and by having the center bored out and a pin turned to a shrinking fit, the gage heated to the hardening heat and setting the pin in place and quenching, regained sufficient stock to permit the gage to be ground to the desired size.

Davenport, Iowa. C. U. SCOTT.

Boring a Flywheel—Using a Wooden Boring Bar

In reply to G. E. Dawson, page 129, subject, "Boring a flywheel, using a wooden boring bar," will say, that upon referring to the original data from which the article was written, I find that through a mistake of mine in making the sketch, one of the cutters was omitted. There were two cutters placed as nearly as possible directly opposite each other or 180 degrees apart.

It is readily seen by this that it would be impossible for one of the cutters to jump forward while passing a keyway, as the other would be supported by the cut it would be taking at those times.

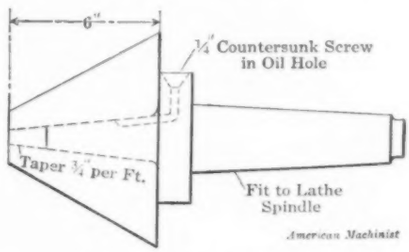
Thanks to Mr. Dawson for noticing the defect.

Cleveland, O. A. DANE.

Cone Centers

Several weeks ago you had an article on cone centers. I have made a number of them that I think are a little better than the design then shown, on account of the oiling system.

Referring to the drawing you will notice that, in my design, the taper hole



IMPROVED CONE CENTER

is all the way through the cone and is ¾ taper per foot. I have these running in sizes similar to standard taper reamers; in other words, one size overlaps the other.

If this is carried out in four sizes to suit conditions of work, it will cover a wide range and as the cast-iron cone becomes warm it can be reamed and faced. I find that a steel center and cast-iron cone give better service than any other material.

Philadelphia, Penn. T. A. W.

Whitaker & O'Brien, wood and metal patternmakers, 228 Aborn street, Providence, R. I., built to the order of the L. A. W. Motor Company, an aëroplane which has been shown at the aëronautical exhibition held in Mechanics building, Boston, Mass., from February 16 to 23. The wood work is of ash, white poplar and spruce. The machine is 22 feet wide, 23 feet long and 11 feet high over all.

Correspondence on mechanical subjects solicited and paid for. Name and address must always be given—not necessarily for publication.

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American Machinist

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION

ISSUED WEEKLY BY THE HILL PUBLISHING COMPANY

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Compensation for Accidents

The position taken by H. H. Franklin in his report to the Commission on Employers' Liability of the State of New York and given on page 322 is well worth the careful consideration of every reader, be he employer or employed. It shows that much thought has been given to the subject and the examples cited from his own experience brand it as practical rather than the vision of a dreamer as is too often the case. The fact that it agrees in some of the essential points with the recommendations of the Federation of Labor, indicates that there are mutual grounds of betterment on which both sides may meet and for which they may work.

In addition to the humanitarian point of view and the many advantages of maintaining harmonious and sympathetic relations between the owner or manager and his men, there is the question of conserving the economic value of the workman both to himself and to the industry, just as of conserving the natural resources about which we are hearing so much at present.

We are so inclined to think of all questions as being individual that we quite overlook the effect on the community or the industry. We are genuinely sorry for the individual workman and his family when he is injured or killed, but we do not often consider that it represents a distinct loss to the industry as a whole.

Every trained mechanic represents an investment in time and energy which makes him valuable to himself, the employer and the industry. When he is injured, this is lost for a time and if he should be incapacitated or killed, the investment is lost while he or his family, or both, may, in addition, become a burden on the community. At the present time, when the training of apprentices is receiving so much attention, it does not take very deep philosophizing to see that anything we can do to prevent accidents, reduces the number of men who must be trained.

Prescribed compensation for injuries, according to Mr. Franklin, directly benefits both employer and employed, but it is probably safe to say that nearly every manufacturer would be perfectly willing to maintain his present liability premium if the injured employee received it all. The increased sympathy and good feeling that would follow would probably be worth more than the amount saved. Then, too, the number of accidents would be very sure to decrease, as more care would be taken to prevent them.

The main point, however, is how accidents can be prevented, for from any point of view they are to be greatly deplored. Accidents are an economic waste in every way and it is a short-sighted policy which considers them in any other way. There is probably no way in which they can be entirely prevented, however, and when they do occur, some form of compensation is the only reparation that the industry can make to the worker.

CIRCULATION STATEMENT

During 1909 *we printed and circulated* 1,209,000 *copies of the* AMERICAN MACHINIST.

Our circulation for January, 1910, *was (American weekly, American monthly, English weekly and Germany weekly)* 116,750.

February 3	39,250
February 10	24,000
February 17	23,000
February 24	23,000

This paper reaches 39,250 *separate readers each month and* 23,000 *each week.*

None sent free regularly, no returns from news companies, no back numbers. Figures are live, net circulation.

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As a further illustration of the increasing interest shown in this country in workmen's compensation schemes, we print below a resolution passed by the National Conference on Uniform Legislation, called by The National Civic Federation and held at Washington, D. C., January 17-19.

At the November meeting of the Federation, held in New York City, several addresses were made, particularly by speakers from Europe, and considerable discussion was given on this and kindred subjects. Apparently the interest then aroused has borne fruit in bringing about the passage of this resolution.

Whereas, the present remedies for compensation for industrial accidents throughout the various States are slow, uncertain and wasteful, and

Whereas, there is not, and cannot be, any equitable solution thereof, based only on the fault of the employer, and

Whereas, twenty-three of the more progressive commercial nations abroad have bettered, and in some instances solved, the problem on the basis of Workmen's Compensation Acts, and

Whereas, we believe that such Acts can be adequately substituted for our present laws and applied to our institutions with equal satisfaction and profit,

Now, therefore, be it

Resolved, that this Conference recommends to the Governors of the several States now assembled in this city, and to the States, that workmen's compensation acts fair to the employer and employee and just to the State, be uniformly substituted for the present system of Employers' Liability for injuries received in and arising out of the course of employment.

Trend of Time Keeping

The familiar method of time keeping in machine shops is to furnish the workman with sheets or cards to be filled out by him and turned into the office. These sheets or cards show the order numbers, jobs, operator's time spent on each, etc., and furnish the fundamental data for all shop costs, and production analyses.

The trend of time keeping is away from this time honored method, and wisely so.

The costs and analyses can be no better, as regards accuracy, than the data upon which they are based. The time credited to particular operations by the workmen may or may not be accurate. It may be inaccurate from dishonest motives, as favoring a job with a low piece rate at the expense of another with a high one, or inaccuracy result from no more questionable causes than carelessness or failure to remember precisely how much time was spent on each job, if several have been done during the day.

What shall we say as to the value of elaborately worked out cost records, based on such original figures? The spring can rise no higher than its source.

During the past few years several machine-shop time-keeping systems have been installed, where the fundamental principle is that the workman shall not keep his own time. In some cases the foreman, or foreman's clerk notes the finishing and beginning of all jobs and makes the necessary entries on the time cards, in others the time-keeping department handles the work more directly. The important point is that someone other than the workman is responsible for the clerical work of keeping time.

This shows the trend of time keeping; away from inaccurate, or at least questionable, original data upon which to base shop costs, toward methods so controlled that they are known to be accurate.

Recent Development of Producer Gas Power Plants

A most interesting and instructive bulletin has been issued by the United States Geological Survey, treating of the growth of producer-gas power plants in this country. It is Bulletin No. 416, "Recent Development of the Producer Gas Power Plant in the United States," by Robert Heywood Fernald.

A reading of this bulletin shows that the use of gas engines supplied with producer gas is destined to play a large part in the power generation of the future. There are many reasons for this opinion, not the least of which is the one of economy. We quote:

"The early tests proved decidedly encouraging, demonstrating that many coals now wasted or not mined because they are not satisfactory fuel for steam-power plants can, by conversion into producer gas, be made to do from two to three times as much work as can be done by the best grade of steam coal fired in a boiler plant."

Many tests on various kinds of fuel have been made by the engineers of the Geological Survey, and these tests have demonstrated that many fuels containing much ash, sulphur and tarry compounds could be used successfully to generate producer gas under conditions of plant that were designed especially for the using of anthracite coal. The testing plant ran satisfactorily on many coals containing over 20 per cent. ash. One West Virginia bone coal had as much as 44 per cent. ash, and with this fuel the consumption was only 1.65 pounds of coal as fired per brake horsepower per hour.

Among the other fuels which may be classed as low grade, and which have been successfully used in this plant, are: large slaty roof coal, Illinois bone, washery refuse and Rhode Island graphitic anthracite.

In regard to the relative thermal efficiency of steam plant and gas-power plants, Mr. Stott, superintendent of motive power of the Interborough Rapid Transit Company, of New York City, is quoted as giving the total losses in British thermal units for one pound of coal containing 12,500 British thermal units converted into electricity in a steam plant of the Interborough company as 11,213, and the energy utilized as 1287, representing, respectively, a loss of 89.7 per cent. and energy utilized of 10.3 per cent. Mr. Stott gives comparable figures for producer-gas power plants as; total losses 76 per cent., energy utilized 24 per cent. Mr. Fernald, however, is somewhat more conservative in his estimates, placing the corresponding thermal efficiency of the producer-gas plant at 21.5 per cent. Accepting this latter quantity, we see that the producer-gas power plant is twice as efficient thermally as the steam-power plant.

On pages 15 and 16 a lengthy table is presented, giving the total pounds of coal of various kinds fired per electrical horsepower-hour developed at the switchboard for both steam and producer-gas power plants, together with their ratio. These ratios run from 2.1 to 3.87. Such figures can well bear considerable study on the part of anyone contemplating installing a factory-power plant.

Some 12 pages of this bulletin are devoted to an analysis of answers received to a series of questions sent out to representative manufacturers of producer-gas power plants. These pages are highly instructive, but space does not allow us to consider them in detail. The points investigated through these questions are: Reliability, lack of engineers, inexperienced salesmen, unsuccessful installations, design and construction, public uncertainty, separate heating plants, use with bituminous coal, cheap fuels in suction producers, relative fuel values, excessive cost and overrating.

Of these the two points which apparently cause the most difficulty in introducing such plants are "public uncertainty" and the necessity of "separate heating plants." In regard to the first it is undoubtedly a fact that the public is rapidly gaining knowledge and confidence in the use of gas power; in regard to the second, it must be recognized that in many localities steam plants are required, both for shop heating during cold weather and to furnish steam for industrial purposes. It is probably true that in many places where producer-gas power plants would otherwise be desirable this feature of shop heating makes it a mistake to put in such an installation. In regard to cost it is pointed out that in small installations the balance is in favor of the steam plant. However, the increased efficiency of the gas-power plant in operation will make up this difference in first cost within a very short time; probably within a very few years.

PERSONALS

Items For This Column Are Solicited

Edwin C. Foster, recently president of the New Orleans Railway and Light Company, has become associated with Sanderson & Porter, consulting engineers, New York City.

William B. Stoops, of Youngstown, O., has accepted the position of manager of the Portsmouth Steel Company, Portsmouth, Ohio, beginning by superintending the construction of the large addition to the plant.

C. H. Taylor, until recently connected with the engineering department of the E. R. Thomas Motor Company, Buffalo, N. Y., has been appointed chief engineer of the Hudson Motor Car Company, Detroit, Mich.

Frank A. Foster, mechanical engineer, Providence, R. I., and now with the American Locomotive Company, will leave for China about March 1, where he will look after machinery in, and mechanical part of, railroad work. Mr. Foster will be located at Davenport Road, Tientsin, China, care of Albert C. Lee.

An illustrated lecture on the development of the automobile torpedo, with special reference to the Bliss-Leavitt type, was delivered by Samuel Aronson, connected with the editorial department of the AMERICAN MACHINIST, before the Providence Association of Mechanical Engineers at their monthly meeting on February 15.

NEW TOOLS and MACHINE SHOP APPLIANCES

Showing New Ideas in Machine Shop Equipment that make it possible to do better work at a reduced cost

ANY new or improved machine or shop appliance of interest to our readers will be illustrated and described in this department.

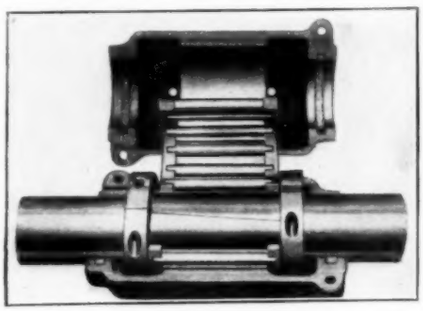
A full and more detailed description will be given—when of special interest and it appears here before being sent elsewhere.

ALL descriptions appear in all four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

A Roller Bearing

The halftone shows a roller bearing which is being put on the market by the Royersford Foundry and Machine Company, Royersford, Penn.

The bearing is split and consists of a hardened-steel bushing, split at an angle



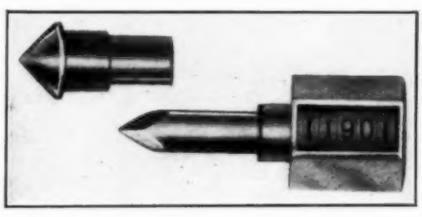
A Roller Bearing

to prevent stalling of the roller cage. This bushing fits the shaft to which the roller bearing is to be applied. The roller cage is also in halves and fits between the flanges of the bushing. The outer cover is fitted closely to prevent dust working in and the ends are fitted with felt washers, as shown, for the same purpose.

Tapped holes for oil cups are in the upper box and the bottom box is provided with ample reservoirs at each end for the lubricating oil. All end thrust is avoided as the bearing is of the floating type.

A Speed Counter

The cut is but a trifle smaller than the new Veeder direct-speed counter No. 2, which, as can be seen, is very com-

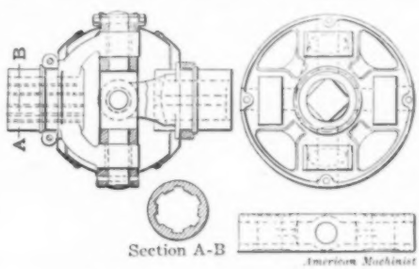


A Speed Counter

pact and convenient to use. This counter is supplied with one pointed rubber tip which slips over the angular metal tip. This counter is made by the Veeder Manufacturing Company, Hartford, Conn.

Large Universal Joint

The Kinsler-Bennett Company, of Hartford, Conn., has brought out a new design of a 7-inch universal joint to meet the increasing demand of motor trucks and heavy touring cars. The design embodies several new features, the forks being made of heat-treated material to stand heavy strains. The holes in the arms of the forks are bushed with tool-steel bushings, and are hardened and



Large Universal Joint

ground. The hubs are made for either round, taper or broached hole, such as may be the requirement.

The plate is also made from the same steel as the forks, having rectangular holes which allow the forks to be inserted, and the pins are of tool steel hardened and ground. A hole is drilled at the outer end of pin and a screw having a castle nut is used through the plate and pin, making it stationary, so that when the forks oscillate it confines the wear to the bushing in the forks and the pins. This also holds the inside cover to plate. Bushings and pins can be replaced at a very small cost. The outside covers are held in place by a wedge clamp and have screws drilled for cotter pins and castle nuts. All joints have dust-tight covers so they can run in oil or grease as desired.

A Thread Milling Machine

The illustrations show the principles involved in the thread-milling machine being built by the Milled Screw and Machine Company, Sayre, Penn.

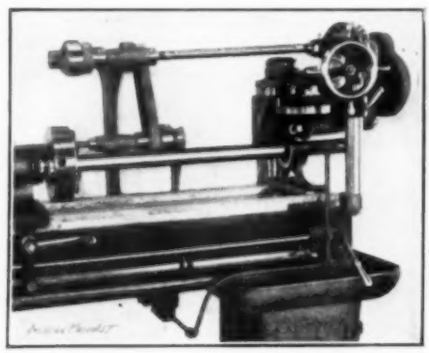


Fig. 1. Head of Thread Miller

Fig. 1 shows the head of the machine with the milling cutter set to the desired angle by the swiveling head which is supported from above. The head is adjusted vertically on the round column at the back of the machine, and the spindle is driven through gearing inclosed in the case at the right. The method of supporting the work directly under the cut is clearly shown.

The work is held in the chuck at the left and is driven by endless belts and universal joints from the same shaft as drive the milling cutter through the lower shaft to the worm- and spur-gearing train, shown in Fig. 2. This revolves and gives longitudinal motion to the

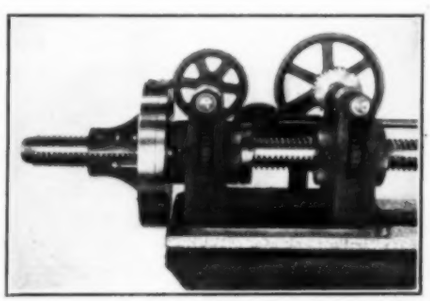


Fig. 2. Gearing Which Drives the Work

splined screw which controls the movement of the chuck carrying the work. Any desired thread can be milled by the use of the proper chain gears, and the whole machine appears to have been

designed with a view to simplicity and adaptability for different kinds of work.

Its operation is so clear that further description seems unnecessary. They also build a vertical machine for cutting large worms with an end milling cutter.

A Convenient Vertical Spindle Milling Machine

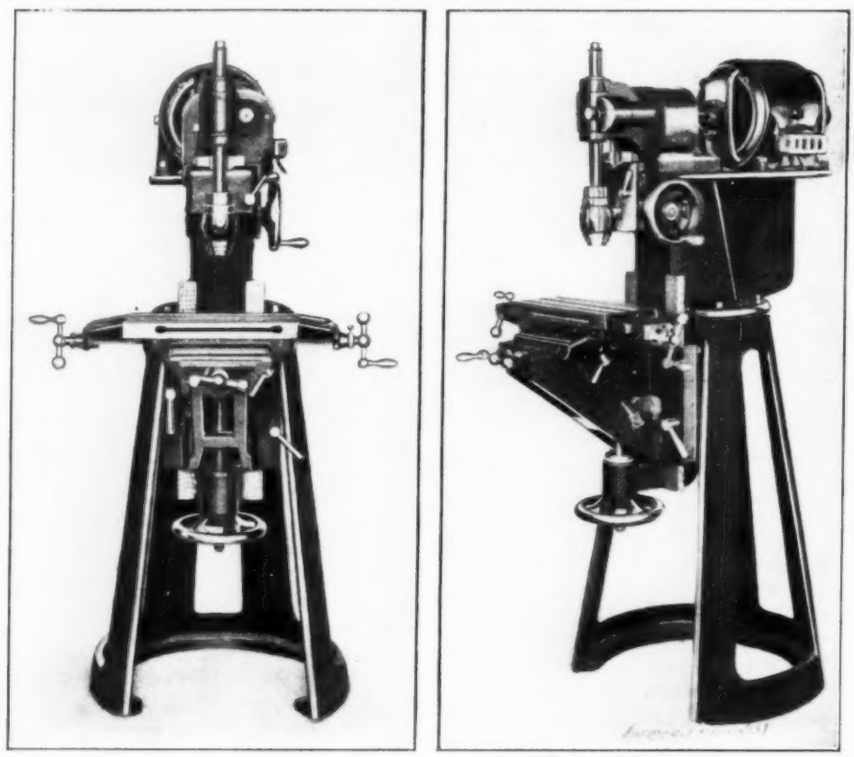
The illustrations show a very convenient form of vertical-spindle milling machine designed by C. K. Tripp, of the General Electric Apprentice School at West Lynn, Mass. This was designed particularly for laying out, drilling and boring small jigs, profiling and milling small dies and other experimental work.

The spindle is driven by a variable-speed motor through spiral gears and has three changes of speed, 600, 1200 and 2400 revolutions per minute. It is fitted with a spring chuck which is interchangeable with the bench lathes in use. The spindle is of tool steel and the bearing linings are of bronze, tapered for adjustment.

The table is 6x14 inches, has three T-slots, a longitudinal feed of 8 inches and a cross feed of 6 inches. The knee is fitted to the column by rectangular ways and has a vertical movement of 9 inches.

Both cross and longitudinal feed screws are fitted with good sized micrometer dials, which are used for ordinary work and have a sensitive micrometer attachment provided for precision work.

The machine is designed to be used on either bench or pedestal, and it will be noted that the pedestal is of unusual design, being open in front so as not to interfere with the feet of the operator in any way. It is arranged for a one-half horsepower motor, either alternating or direct current, or it can be run by a belt from a countershaft. The change-speed gears are made of tool steel and cloth and are practically noiseless.



CONVENIENT VERTICAL MILLING MACHINE

A New Abrasive

A new abrasive called "corubin" is now being supplied to the American market by the Goldschmidt Thermit Company, New York City. This material is a by-product formed in the manufacture of chromium by the thermit process. It consists of aluminum oxide with traces of chromium in it, although entirely free from contained moisture. The material is used extensively abroad as an abrasive, for which purpose it is supplied in three grades, coarse, medium and fine.

Corundum Oil Stones

The American Emery Wheel Works, Providence, R. I., has just brought out a line of corundum oil stones. These are made 4, 5, 6, 7 and 8 inches long in three grades—fine, medium and coarse—and are impregnated with vaseline so that they need very little lubricant.

Furnaces for Natural Gas or Oil Fuel

The halftones show furnaces for use with either natural gas or oil fuel.

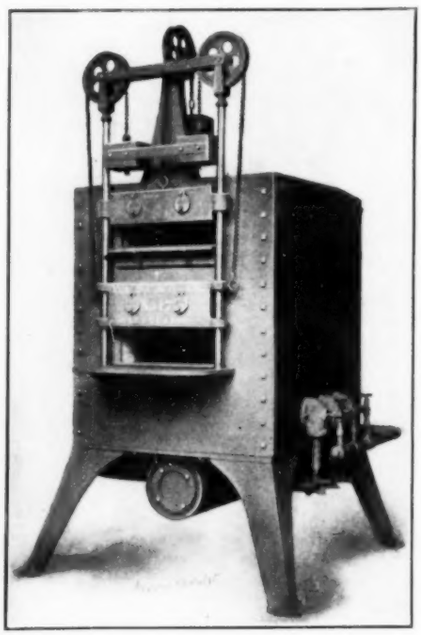


FIG. 1. HEATING, ANNEALING AND TEMPERING FURNACE

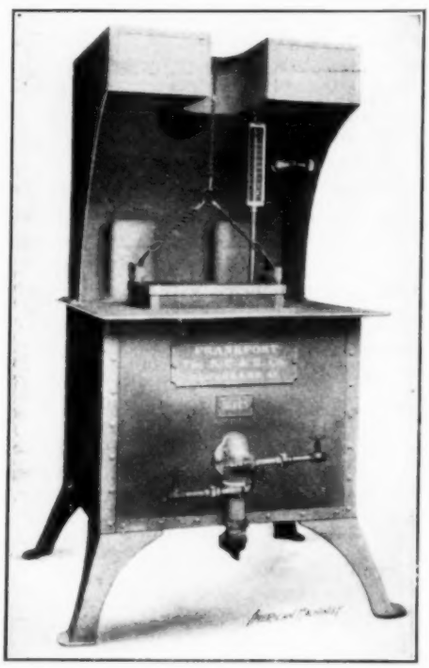


FIG. 2. OIL TEMPERING FURNACE WITH OIL BURNER

Fig. 1 shows a heating, annealing and tempering furnace with preheating oven. The heating chamber, which is underneath the preheating oven, is 29 inches wide, 24 inches deep and 12 inches high with a front opening 20 inches wide by 7 inches high.

The preheating oven is 29x24x8 inches and has a door 20x5 inches. It is equipped with six burners, as shown, for natural gas, or with one oil burner as desired.

Fig. 2 shows an oil tempering furnace equipped with an oil burner. The oil pot measures 15x21x11 inches deep inside and has a capacity of 10 gallons oil. The basket measures 14½x20x11 inches deep.

Fig. 3 shows a hardening furnace for vise jaws with six jaws in position for heating. It is furnished either with or without the auxiliary oven shown to the right and is made to be fired either with natural gas or oil. These furnaces are built by the Strong, Carlisle & Hammond

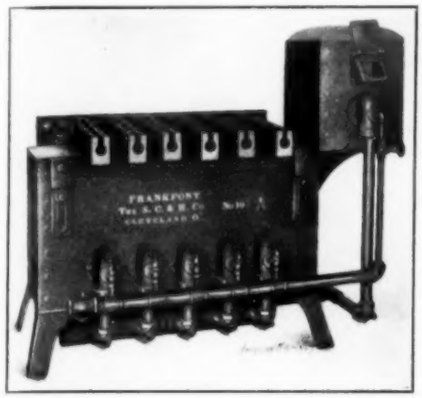
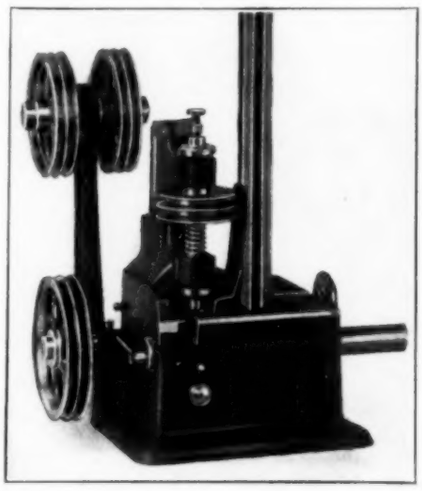


FIG. 3. FURNACE FOR HARDENING VISE JAWS

Company, 236 Frankfort avenue, Cleveland, Ohio.

An Automatic Vertical Recessing Machine

The halftone shows a machine for recessing watch parts, such as bridges, etc. The work is held stationary while it is roughed or finished by a revolving cutter. The blanks are placed in the vertical rack or magazine and all subsequent operations are automatic. The feed and clamping mechanisms are operated by compressed air and the work and chips are ejected by a blast of air. The machine is best adapted for brass work and will finish from 12 to 20 pieces per minute, one operation, according to the size of the recess. It is built by the Waltham Machine Works, Waltham, Mass.



AN AUTOMATIC VERTICAL RECESSING MACHINE

Reversing Tapping Chuck

The illustrations show the operation of the new reversible tapping chuck made by the Pawtucket Tool Company, Pawtucket, R. I.

Fig. 1 shows the outside of the chuck together with the rod which screws into the body and prevents it from turning with the tap. In Fig. 2 are the gear *C* and stud *D* which is screwed into the shank *E*. The stud *D* has two driving slots on the face of it. The tap holder *B* is pinned to the clutch *A*. This clutch has tongues at each end on opposite sides of it which engage slots in *D* on the top and in the sleeve *H* on the bottom. The sleeve *H* is keyed to the gear *G*. The idler *F* transmits motion from *C* to *G*, of course in the reverse direction. As *G* is smaller than *C* it turns faster than *C*. A collar *I* on *H* holds it in place, as does also the idler gear *F*.

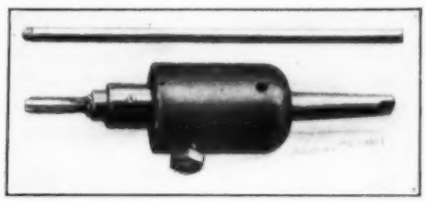


FIG. 1. REVERSING TAPPING CHUCK

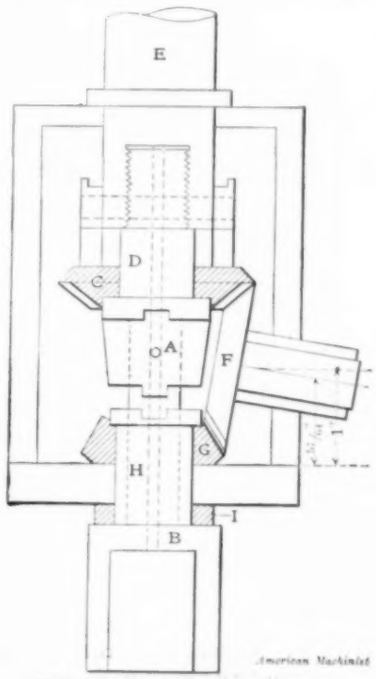
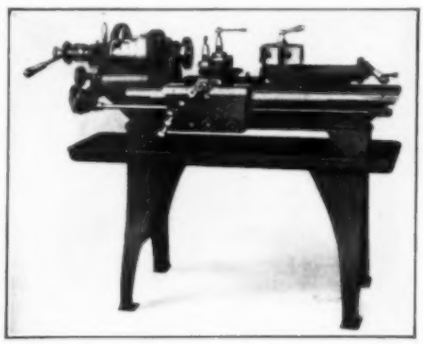


FIG. 2. DETAILS OF REVERSING MECHANISM

When tapping, the spindle of the machine is brought down till the tap strikes the work and lifts *B* and the clutch *A* into engagement with *D*, which drives the tap into the work. When the tap is at its proper depth the spindle of the drill is raised, which lifts the piece *D* out of engagement with *A* and further movement causes *A* to engage the reverse running sleeve *A* and the tap is backed out at high speed. This device will drive taps from ¼ to 1 inch diameter.

New Lathe Attachments

The illustration shows a Star lathe equipped with an automatic turret on the bed, a draw-in chuck and automatic rod feed in the head and a double tool block on the cross slide. The turret slide has an adjustable stop, the turret is automatically revolved and has its six faces finished square with the ways so that tools may be bolted to it, and the turret post has a hole through it.

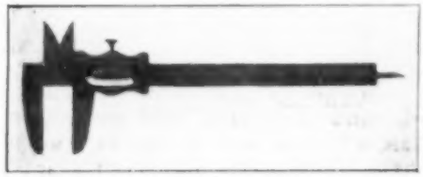


NEW LATHE ATTACHMENTS

The chucking device allows rod work to be done without stopping the machine by the proper handling of the hand lever at the left. The double tool post can be used for cutting off or for forming, and can easily be interchanged with the regular plain or compound rest. The combination is supplied with either the 9- or 11-inch lathes made by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y.

Columbia Vernier Caliper

The illustration shows a combination inside and outside Vernier caliper which is made by E. G. Smith, Columbia, Penn. There is also a very convenient depth gage connected to the sliding jaw and which can be read by the same gradu-



COLUMBIA VERNIER CALIPER

ations as the caliper jaws themselves. These are graduated in several different ways, the one shown having a capacity of 5½ inches and reading to 128ths of an inch, while the lower scale is metric. It is furnished in a leather case for the pocket.

An Emery Wheel Dresser

It is intended that the emery wheel dresser shown in the halftone shall be used from the side of the wheel so that the operator stands in such position that his eyes are in no danger from the flying

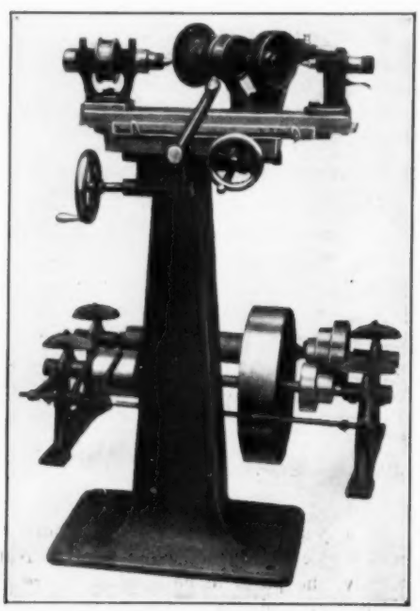
EMERY WHEEL DRESSER

particles and should the wheel break while being dressed, which has happened, his body is out of the way of the flying pieces.

It is made by the F. G. Marbach Company, Medina, Ohio.

Improved Cutter Grinder

The Miami Valley Machine Tool Company, Dayton, Ohio, has made changes in its plain and universal cutter grinders. A crank handle is used on both machines instead of a hand lever as formerly. The tables swivel for grinding tapers and are graduated at one end. The grinding head also swivels in place of the body of the machine, giving a quick adjustment, and



IMPROVED CUTTER GRINDER

permits machines to be placed close to the wall or to other machines. Both external and internal spindles are carried in the same head. The only vertical adjustment required is for backing off taper reamers and is secured by a ring at the base of the grinding head. Both machines will handle work 8 inches in diameter and milling cutters up to 16 inches. The plane machine weighs 400 and the universal 500 pounds.

A Speed Lathe

Fig. 1 shows a motor-driven lathe designed for shop and manual-training school use.

The belt-driven lathes can be set up in rows to drive from an overhead line shaft as shown in Fig. 3 or from a shaft under the bed, as shown in Fig. 2, suitable clutch pulleys being provided on the line shafts. When the line shaft is under the bed suitable guards are provided to avoid accidents. The spindles run in ring oil-

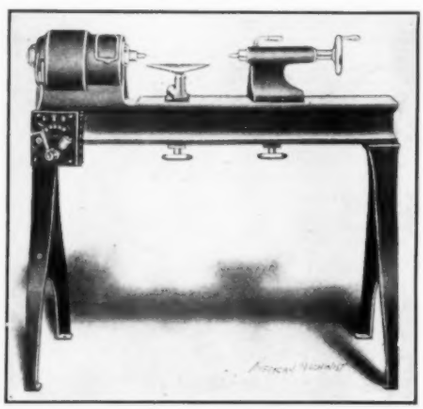


FIG. 1. MOTOR-DRIVEN SPEED LATHE

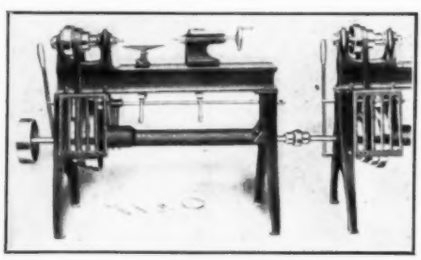


FIG. 2. CLUTCH DRIVE FROM BELOW

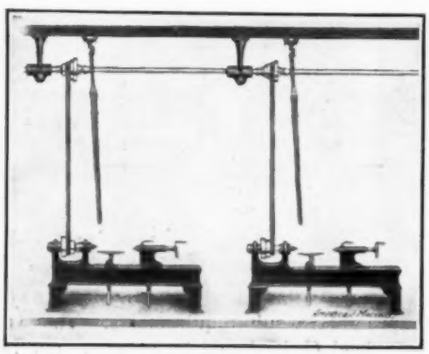


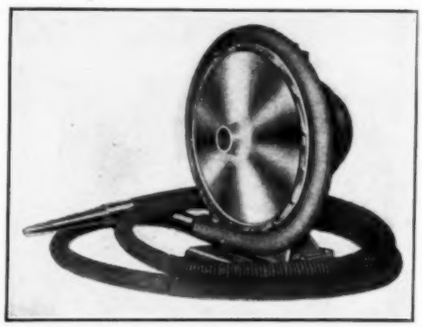
FIG. 3. OVERHEAD CLUTCH DRIVE

ing taper bronze boxes. These lathes are built by F. E. Wells & Son Co., Greenfield, Mass.

A Portable Blowing Set

The halftone shows a small specially designed aluminum fan and case driven by a direct-connected electric motor, built to operate from lighting circuits.

The flexible reinforced air hose is 1¼ inches diameter and 12 feet long; the electric-light cord is 20 feet long, giving a working radius of 32 feet from any electric-light socket.



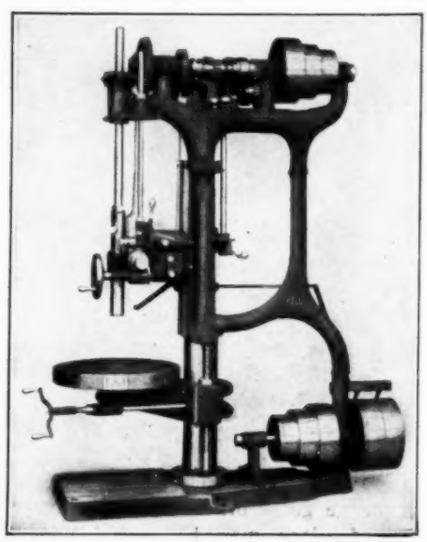
PORTABLE BLOWING SET

With this device dirt and dust can be either blown or sucked from machinery, etc. It is built by the B. F. Sturtevant Company, Hyde Park, Mass.

A Drill Press

The halftone shows a 25-inch high-speed upright drill. The 3-step cone and double back gears provide nine changes of spindle speed. The double back-gear construction permits the use of wide cone steps of large diameters, and the cone belts are always running at comparatively high speeds.

The tapping attachment is located on the top housing between the driving cone



A DRILL PRESS

and the double back gears. It is operated through spur gears and clutches by a lever which extends out to the side of the column, and by means of which the spindle may be started, stopped, and reversed at an accelerated speed. When this lever is in its neutral position, the entire machine, with the exception of the cone pulleys, is brought to a standstill.

Positive geared feed is mounted on the sliding head, and provides eight distinct rates of feed, advanced in geometrical progression 0.006 to 0.050 inch per revolution of spindle.

Automatic stop and depth gage are provided, which, through the medium of graduation on the spindle sleeve, permit tripping the spindle at a desired point from any position within the limits of its travel.

All levers are placed on the right-hand side of the machine, and may all be manipulated by the operator without change of position.

This machine is built by the Kern Machine Tool Company, 4657 Spring Grove avenue, Cincinnati, Ohio.

Special Graduating Machines *Editorial Correspondence*

The Oesterlein Machine Company, Cincinnati, Ohio, uses some interesting special apparatus for graduating feed-screw dials, swivel bases for cutter-grinder heads, side plates for milling-machine dividing heads, etc., some of this work requiring graduations which read to thousandths, while other members are divided to read in degrees.

For graduating such work the machine in Fig. 1 has been devised by Mr. Oesterlein; this being operated by hand and accomplishing results quickly and with accuracy. The arrangement of the machine is such that by means of the necessary change gears practically any number of graduations may be placed upon the periphery of the work.

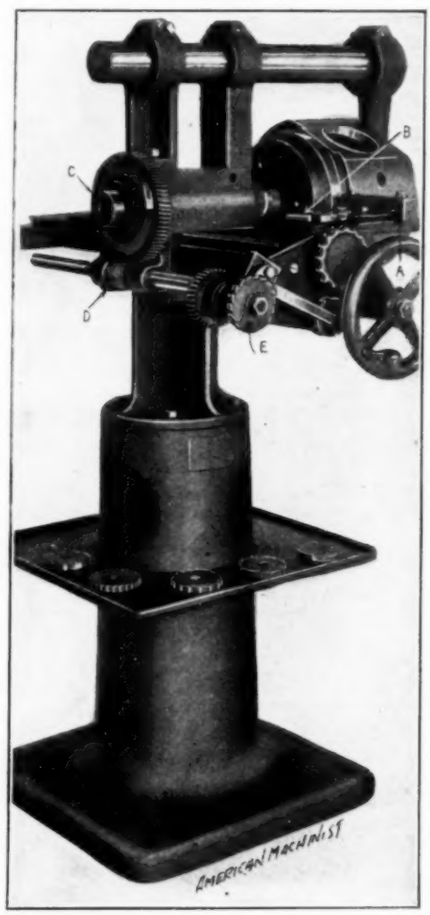


FIG. 1. GRADUATING MACHINE

THE RECIPROCATING MECHANISM

The graduating tool, a detail of which is shown in Fig. 2, is carried in a holder secured to a reciprocating slide *A*, operated by a multi-lobe cam *B*, mounted upon the upper end of a vertical spindle, which in turn is actuated by bevel gearing from the handwheel in front. In the general view the cam shown has five lobes, though cams of various kinds may be interchanged with the one illustrated, according to the character of the graduations required. With the five-point cam,

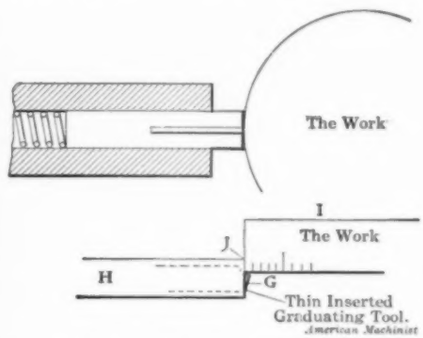


FIG. 2. SPRING-CONTROLLED GRADUATING DEVICE

which is used for cutting four short lines of uniform length and a fifth line longer than the preceding ones, four of the lobes, of course, are of equal length, the remaining one being longer by an amount sufficient to give the extra length for the fifth line in the series of graduations.

OPERATION OF THE WORK SPINDLE

The work spindle, which is provided with a No. 10 Brown & Sharpe taper hole, is rotated intermittently, that is, advanced step by step to index the work before each graduating strike, by worm wheel *C* and worm *D* at the rear, the worm being operated by spur gears which derive their motion through the medium of ratchet wheel *E* and a pawl operated by a rod and a crank disk *F* from the handwheel in front, which also reciprocates the tool slide. Several ratchet wheels will be noticed on the table around the column, and by means of these interchangeable ratchets the number of divisions may be varied to suit requirements. The worm wheel *C*, it should be noted, is not fastened directly to the spindle, but is held by means of adjusting screws so that the work may be rotated, and set to a line if necessary, without turning the gearing.

The graduating slide is so constructed that it may be swiveled through a quarter

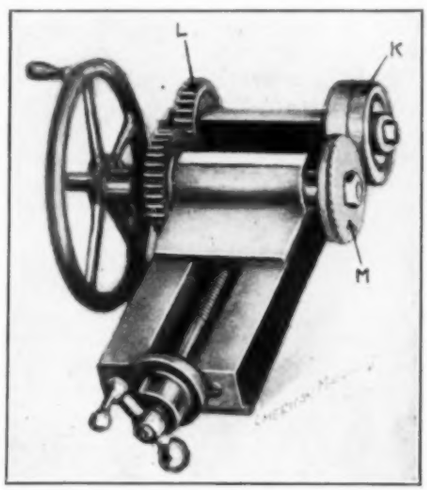


FIG. 3. MARKING DEVICE

circle and lines can be graduated on surfaces parallel to the spindle, or at any angle to the spindle up to 90 degrees.

For small collars and dials which are to be graduated, the regular holding arbor is sufficiently stiff of itself to insure neat results; where larger and heavier work, like that shown in position in the illustration, is mounted for dividing, the overhanging arm is brought into use as shown to support the outer end of the work arbor.

THE CUTTING POINT

The graduating tool consists of a thin cutting blade, or needle point, shown at *G*, Fig. 2, which is inserted in holder *H*, normally pressed forward in its seat in the reciprocating slide by a spring at the rear end. The spring pressure tends always to hold the front end of carrier *H* in contact with the periphery of the work *I*, as indicated at *J*. The object of this is to insure equality in the depth of all the graduations, even though there should be for any reason a minute amount of eccentricity in the work itself. Naturally, the parts to be graduated are finished concentrically, but in the event of any slight error in this direction creeping

into the work it will in no way affect the accuracy or the appearance of the series of graduations.

Marking Fixture for Numbering Graduations

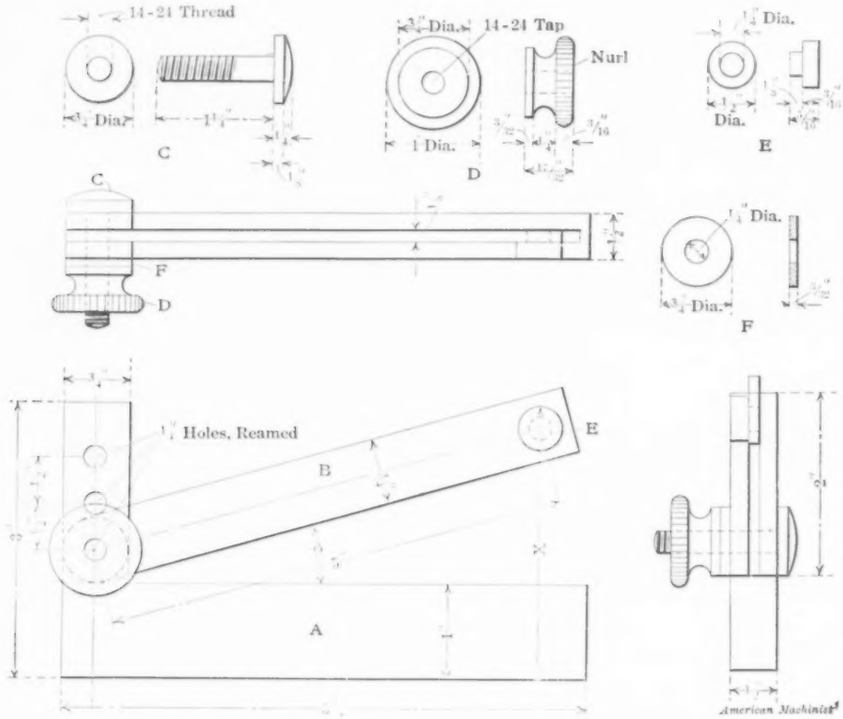
The fixture in Fig. 3 is provided at one end with a fixed bracket or head, in which is mounted a spindle for holding the work *K*, and the operating gear *L*, while at the other end of the fixture is located a handle upon a screw with graduated dial, by means of which an adjustable head is slid along the guide which forms the body of the fixture. This adjustable head carries also a spindle geared to the first spindle mentioned, and operated by the hand wheel. This spindle carries upon its outer end a circular disk *M* upon the edge of which are engraved in raised characters the series of figures, which are to be impressed upon the graduated dial, or other part. These figures are so engraved on their dial as to match, say, every fifth or tenth line, as may be desired. A special marking dial must be made for each size or type of piece to be marked and this dial must be the same size as the work. The two gears which rotate the work and marking spindles in unison are of the same diameter on the pitch line as the work itself.

A Bevel Protractor for Accurate Work

By J. E. May

A bevel protractor that can be adjusted to various angles as accurately as a vernier hight gage can be set is shown in the drawing.

Referring to the engraving, part *A* is of tool steel, hardened and ground, the three ¼-inch holes being accurately located and lapped to size; this is extremely important as will be shown later. *B* is the blade, also of tool steel hardened and ground all over. Parts *C* and *D* need no explanation. *E* should be ground exactly to size and riveted lightly in *B* before the edges of the latter are ground.



Bevel for Accurate Work

While the uses of this tool are numerous it was designed especially for obtaining the included angle of armature die sections. These come of various angles, depending upon the number of slots in the die, and read in some cases, to seconds of arc. As the dimensions of the sections vary in different dies the reason for having three ¼-inch holes is to accommodate the different sizes, by changing the stud to the hole most convenient to use. The formula by which the protractor is set is the following:

$$t = 5 \sin. \phi + 1 + \tfrac{1}{4} + \tfrac{3}{8},$$

the result being expressed in inches and parts. If the upper hole is used 1 inch is to be added to the quantity; if the middle hole is used ½ inch is to be added to *X*.

A vernier hight gage being set the required hight the protractor blade is adjusted so that the gage will just pass over the button *E*. As die sections are usually planed on a shaper that has an adjustable platen, after the correct angle is once obtained no further reference need be made to the protractor until a new angle is required. It has been found in practice that this tool is capable of being set with a greater degree of accuracy than any of the regularly graduated protractors.

The name we gave to the tool was "sine-protractor," for want of a better one.

Fayette Brown

Fayette Brown, president of the Brown Hoisting Machinery Company, Cleveland, Ohio, died on Thursday, January 20, in his 87th year.

FORTHCOMING MEETINGS

Southern Supply and Machinery Dealers' Association and American Supply and Machinery Manufacturers' Association, joint convention, Jacksonville, Fla., April 5, 6 and 7, 1910. Hotel Seminole. F. D. Mitchell, secretary, 309 Broadway, New York City.

National Metal Trades Association, annual convention. Hotel Astor, New York City, April 13-14, 1910. Robert Wuest, Commissioner, New England building, Cleveland, Ohio.

American Society of Mechanical Engineers, spring meetings, Atlantic City, N. J., May 31-June 3. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association and American Brass Founders Association; joint convention, June 7-8-9, Detroit, Mich.; headquarters, Hotel Pontchartrain. Richard Moldenke, secretary, Watchung, N. J.

National Gas and Gasolene Engine Trades Association. Semi-annual convention, Cincinnati, Ohio, June 13-16, 1910; headquarters, Hotel Sinton. Albert Stritmatter, secretary, Cincinnati, Ohio.

Master Car Builders Association; annual meeting June 15-17, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

American Railway Master Mechanics Association, June 20-22, Atlantic City, N. J. J. W. Taylor, secretary, Old Colony building, Chicago, Ill.

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

American Society of Mechanical Engineers; monthly meeting first Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month. Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Phil. Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

INCREASING · SHOP · CAPACITIES
where More Tools will be needed

J. A. Newell will put up a creamery at Merrill, Wis.

The Victoria Mills, Thornton, R. I., will erect a new boiler house.

Crane & Co., Dalton, Mass., is to build an addition to its paper mill.

The citizens of Huron, S. D., will install new pumping machinery, etc.

The Michigan Screw Company, Lansing, Mich., will erect a new factory.

The Eagle Brewing Company, Waterbury, Conn., is to erect an ice plant.

Sprattler & Mennell, Paterson, N. J., are going to increase its power plant.

The Diamond State Fiber Company, Bridgeport, Penn., will enlarge its plant.

The Hercules Concrete Pipe Company, Montour Falls, N. Y., is erecting a plant.

The Rock Island Railroad is preparing to build machine shops at Liberal, Kas.

The S. W. Miller Piano Company, Sheboygan, Wis., will erect a new factory.

The Malleable Iron Works, Dayton, Ohio, is to build an addition to its plant.

The Nairn Linoleum Company, Kearny, N. J., is to erect a $100,000 addition.

The Gridley Dairy Company, Milwaukee, Wis., will erect a new $50,000 building.

Fire partially destroyed the factory and foundry of A. E. Kupkey, Perth, N. B.

The Hart Grain Weigher Company, Peoria, Ill., will erect an addition to its plant.

The Bridgeport (Conn.) Malleable Iron Company will erect a new engine room.

The Public Service Corporation will increase its power plant at Cranford, N. J.

The Northwestern Railroad has plans for a new roundhouse at Belle Fourche, S. D.

H. L. Bauman, Newark, N. J., will erect a $45,000 garage at 37-39 William street.

Fire destroyed the woolen mill of Holden & Fuller, Palmer, Mass. Loss, about $75,000.

W. C. Thairlwall & Co., Cambridge, Mass., silk manufacturers, will erect a new factory.

The Continental Sugar Company, Cleveland, Ohio, will erect a $1,000,000 plant in Toledo.

The Neptune Packing Company will establish a sardine packing plant at Boothbay, Me.

The Harrisburg (Penn.) Engineering Company is in the market for malleable iron castings.

It is said the Homer (Mich.) Gas Engine Company is to establish a plant at Marshall, Mich.

The Standard Mirror Company, Pittsburg, Penn., will erect a branch plant at Winston, N. C.

Brown & Boggs, Hamilton, Ont., general machinists, will erect a $5000 addition to it shop.

The stave mill of A. J. Asher, Jr., at Mill Rice, near Pineville, Ky., was burned. Loss, $20,000.

The Vulcan Iron Works, Vancouver, B. C., will erect a new blacksmith shop to cost $30,000.

The Rutland (Vt.) Railroad is preparing plans for a new boiler shop to cost about $60,000.

Fire destroyed the smelting works of Harry K. Fort, Philadelphia, Penn. Loss, about $15,000.

Authentic news is solicited for this department. Real opportunities for the sale of machinery of any kind.

The Rock Island (Ill.) Plow Company is planning the erection of three additional buildings.

Hotel Touraine, Boylston and Tremont streets, Boston, Mass., is adding an extensive ice plant.

The Compton Shear Company, Newark, N. J., will spend about $20,000 in enlarging its factory.

The Portsmouth (Ohio) Steel Company is building an addition to its plant to cost $1,000,000.

The Andrews Furniture Company, of Chicago, Ill., is seeking a location in Centerville, Iowa.

The East Jersey Pipe Company, Paterson, N. J., is to spend about $25,000 in improvements.

The P. H. Hanes Knitting Company, Winston-Salem, N. C., will erect a new $250,000 cotton mill.

The machine shop of the Victor Tool Company, Waynesboro, Penn., recently burned, is to be rebuilt.

The Graham-Bumgarner Company, Parkersburg, W. Va., shoe manufacturer, will erect a new plant.

The Hudson Hat Manufacturing Company, Newark, N. J., is to erect a new factory to cost $27,000.

The city clerk of Oconomowoc, Wis., will advertise for bids for a new boiler for the water works.

The plant of the Lyon Rubber Company, Akron, Ohio, was burned, causing a loss of about $65,000.

It is reported the Armour Packing Company will erect a new cold-storage plant at St. Joseph, Mo.

The Rockwell Silver Company, Meriden, Conn., is planning the erection of an addition to its plant.

The Winsted (Conn.) Hosiery Company has awarded contract for the construction of a four-story addition.

Fire destroyed the carriage works of the Sargent Cart and Carriage Company, Geneseo, Ill. Loss, $10,000.

The Main Central Railroad is to build a new roundhouse at Waterville, Me., and make other improvements.

The Mill Shoals (Ill.) Cooperage Company will erect a barrel-stave factory at Herman, near Jonesboro, Ark.

The main building of the Delaware River Steel Company, Chester, Penn., was burned. Loss, about $100,000.

The Connecticut Street Railway Company, New Haven, Conn., will build an addition and install turbine engines.

It is reported that the Erie Railroad is again considering the erection of a big car shop at Hornell, N. Y.

The Model Malleable Range Company, Ltd., Chatham, Ont., has secured site on which a new plant will be built.

The United States Electric Porcelain Company, Findlay, Ohio, will move its plant to New Cumberland, W. Va.

H. B. Ives Company, New Haven, Conn., manufacturing builders' hardware, is preparing to build an addition.

The Buffalo, Rochester & Pittsburg Railway Company will establish a large tie-treating plant in Bradford, Penn.

The Independent Button and Machine Company, Chicago, Ill., is having plans prepared for a three-story addition.

The Manchester Biscuit Company, of Sioux Falls, S. D., will probably erect a factory at Fargo, N. D., this summer.

The Wells Estate, Milwaukee, Wis., will erect a $35,000 garage. Cary, Upham & Block, Wells building, attorneys.

The Argus Battery Company, of New York, will move to Willimantic, Conn. The company manufactures dry batteries.

Louis Janssens, Raismes, Nord, France, desires catalogs and quotations on machinery for cutting out sheet-metal washers.

The Turner & Sons Sash and Door Company, Grand Forks, N. D., contemplates enlargement of its plant this summer.

The installation of an electric-light plant at Gettysburg, S. D., is projected. R. B. Fiske and J. A. Lake are interested.

The Thomas & Albright Foundry Company, Goshen, Ind., is planning the erection of a new casting plant and machine shop.

The Wisconsin Traction, Light, Heat and Power Company will double its steam plant at its power house in Appleton, Wis.

Douglas & Co., Cedar Rapids, Iowa, starch manufacturers, will build a branch plant in Kansas City, Mo., to cost $175,000.

The E. B. Eddy Company, Ottawa, Ont., manufacturing paper, matches, etc., intend building a new plant on a large scale.

The American Sash and Door Company, Kansas City, Mo., will erect a three-story building to replace one recently burned.

The planing mill of the Pine Tree Manufacturing Company, at Little Falls, Minn., was destroyed by fire. Will be rebuilt.

The Peoria Terminal Railway Company will shortly award contracts for the erection of new car shops in South Bartonville, Ill.

The Heany Lamp Company, of York, Penn., will erect a branch plant at Weehawken, N. J., which will employ over 1000 hands.

The Grand Rapids (Minn.) Electric Light and Water Works will probably install a new pump this summer. Mr. Wagner, engineer.

The C. T. Reineck Company, Ltd., will build a plant at East Calgary, Canada, for the manufacture of stoves and kitchen ranges.

The shops of the Pere Marquette, at Saginaw, Mich., are to be considerably improved and will give employment to 500 more men.

The Lake Charlis (La.) Board of Trade is said to be negotiating for the location there of a large engine and motor-building foundry.

The Tarrant Foundry Company, Chicago, Ill., has bought site on which a new plant will be erected at a cost of about $100,000.

The Chicago, Milwaukee & Puget Sound Railway has begun the construction of its large repair and car shops at Tacoma, Wash.

The Schwarzschild & Sulzberger Packing Company, of Chicago, Ill., will build a $3,000,000 packing plant in Oklahoma City.

Plans have been filed for a six story factory for the Gledhill Wall Paper Company at 541-545 West Thirty-fourth street, New York.

The Kahn Trussed Concrete Steel Company, Youngstown, Ohio, has let contract for the erection of a large addition to its plant.

Procter & Gamble, of Cincinnati, Ohio, have purchased site in Charlotte, N. C., on which a large cotton-oil refinery will be built.

Madhubjee Luxmondas & Co., Block K, Sitaram building, Bombay, India, are inquiring for machinery for making cement from lime stone.

The International Steam Pump Company, 115 Broadway, New York, has an inquiry out for 5500 tons of pig iron for its various plants.

Fire in saddlery and leather goods manufacturing plant of Hugh Carson, Rideau street, Ottawa, Canada, caused a loss of $90,000.

The Baugh Foundry Company, Alliance, Ohio, is making arrangements by which it will probably be enabled to erect a $100,000 foundry.

The Morton Mills, Paterson, N. J., will build an addition to its plant, also a new power house. New engine and boiler will be installed.

The New York Veneer and Seating Company, New York, manufacturing chair seats and table tops, will erect a factory in Jersey City.

The Council Bluffs (Iowa) and Omaha Street Railway Company will erect an additional power house at a cost of $1,000,000, it is said.

The Commonwealth Power Company, Kalamazoo, Mich., will erect during the present year one of the largest electric-power plants in the State.

The New York Baking Powder Company, 102 Murray street, New York, will erect a two story factory in Jersey City to cost about $42,000.

The Jackson-Church Company, Saginaw, Mich., operating machine shop and boiler works, has secured site on which a new pant will be erected.

The main factory building of the Quaker Shade Roller Company, Bay City, Mich., was partly destroyed by fire, causing a loss of about $100,000.

Edward and Harry H. Purvis, machinists, 52 Park street, New York, are erecting a three-story building at York and Jay streets, Brooklyn, N. Y.

The Union Light, Heat and Power Company Fargo, N. D., will enlarge its plant and install additional equipment. Probably mixed pressure turbine.

Isidore de Ochon y Company, Lerdo 41, Veracruz, Mexico, is in the market for wire-nail machinery, bolt cutters, die stocks, rust-preventing greases.

The Hudson (Mich.) Manufacturing Company is considering the establishment of a plant in Salt Lake City for the manufacture of gasolene engines.

The Imperial Steel and Wire Company, in which J. A. Currie, M. P., of Simcoe, Ont., is interested, will erect a factory in Winnipeg to employ 300 hands.

Fire destroyed one of the shops of the Pusey & Jones Company, Wilmington, Del., shipbuilders and manufacturers of paper machinery. Loss, $5000.

The University of Saskatchewan, Saskatoon, Sask., Canada, will erect several new buildings, including power house, agricultural engineering building, etc.

The Wright Wrench Company, at present located in the Aultman building, Canton, Ohio, announces that it will erect a new plant in the south end of the city.

C. B. Gedney, of the Gedney Pickle Company, Minneapolis, Minn., has completed arrangements for the establishment of a pickle factory in Cumberland, Wis.

C. G. Gehom, Bristol, S. D., will remodel the building now occupied by Aberdeen Wholesale Saddlery Company, for an ice-cream factory with 1000-gallon capacity.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., March 14, for hose, packing, gaskets, rubber belting as per Circular No. 563.

The International Harvester Company, Hamilton, Ont., is to spend $100,000 on improvements, including a four-story addition to be used as a machine and erecting shop.

Preliminary plans are being considered by the Superior Motor Vehicle Company, Buffalo, N. Y., recently incorporated, for the erection of two large manufacturing buildings.

The Northern Colorado Power Company, Cheyenne, Wyo., will add to its power plant this summer a 500-horsepower boiler and 500-horsepower direct-connected engine.

The Pacific Board and Paper Company, Seattle, Wash., capitalized at $60,000, has purchased site for a plant. Jas. R. Stirrat, of Stirrat & Goetz, Seattle, is president.

The United Indurated Fiber Company, Lockport, N. Y., has plans drawn for the first of a series of three buildings. About $900,000 is to be expended in improvements.

The Southern Indiana Railroad, which has been in the hands of a receiver, is reorganizing, and a new roundhouse to cost $75,000 will probably be built at Terre Haute, Ind.

The Laramie (Wyo.) Electric Company will remodel its plant, changing from alternating to direct current. Will also install a new 250-horsepower boiler and other machinery.

The State of Missouri has appropriated $18,000 for an experimental station at the School of Mines, Rolla, Mo. Prof. D. Copeland will have charge of purchasing machinery.

The Pittsburg Coal Company, Superior, Wis., is to erect a new coal dock, which, it is said, will be the largest in the world. This will cost $1,000,000 and will be operated by electricity.

The Chandler & Price Company, Cleveland, Ohio, making printing presses and paper cutters, is having plans prepared for a new foundry and power plant for which new equipment is to be bought.

The Ford Motor Company, Kansas City, Mo., has taken out a permit for a new $40,000 building in which it will assemble the parts of all its automobiles marketed in Kansas City and vicinity.

W. F. Havill, Portland avenue, Vincennes, Ind., has taken out a permit for the erection of a factory for the manufacture of motors. The company will be known as the Vincennes Motor Manufacturing Company.

The Gabriel Wagon and Carriage Company, Cleveland, Ohio, is engaging in the manufacture of automobiles, for which purpose a new company has been formed under the name of the Gabriel Automobile Company.

Proposals in triplicate will be received until 11 a.m., March 2, for the construction of a pumping, ice and ice-storage plant at Fort Sam Houston, Tex. Constructing quartermaster has plans and specifications.

Proposals for building power house, installing 100-horsepower gas engines, air compressors, receivers, piping, etc., will be received at the United States Engineers' office, Wheeling, W. Va., until 11 a.m., March 9.

The Uxbridge & Northbridge Electric Company is planning extensive improvements at its power house in Uxbridge, R. I. Contract has been let for a new 500-kilowatt, 3-phase, 60-cycle alternating turbine generators.

The Pennsylvania Railroad will move the roundhouse, machine shops and car shops from Mount Vernon to Bayview Junction, Baltimore, Md., where new shops and roundhouses will be erected at a cost of about $500,000.

Fred W. Lundahl has organized the Moline (Ill.) Pressed Steel Company, with $25,000 capital. Site has been bought for a plant in which will be manufactured implement seats, sheet metal parts for automobiles, tanks, etc.

Plans for the erection of new concrete buildings to take the place of the present wooden ones at the plant of Harvey Hubbell, Inc., Bridgeport, Conn., are being considered. Product is tapping, riveting, slotting machines, etc.

Proposals will be received at the office of the constructing quartermaster, Fort Riley, Kan., until 10 a.m., March 8, for construction of a boiler house and pump pit and furnishing and installing boiler, pumping engine and water main.

The Elgin (Texas) Light and Power Company, capitalized at $15,000, has secured a franchise and will commence erection of a plant for which equipment will be needed. Particulars can be had of Thos. L. Deisch, Box 133, Elgin.

A new $4,000,000 rolling-mill company has begun the construction of a plant in Sydney, N. S., which is to produce 40,000 tons of finished material annually. The names of the promoters can be obtained of the Bureau of Manufactures, Sydney.

The Big Four Railroad is now completing plans for the construction of car shops at Beech Grove, Ind., which it is estimated will cost more than $1,000,000. It is expected that the new building will be ready for occupancy within a year.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., March 3, for paints, oils, varnish, red lead, white lead, alcohol, gasolene, coal tar, sulphate of copper, graphite, aluminum sulphate, etc., as per Circular No. 560.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., February 25, for electrical material, including fixtures, fittings, cable wire, line material, lineman's tools, hardware, insulating material, etc., as per Circular No. 562.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., March 21 for pumps, hoisting engines, push car, spiral-riveted pipe and fittings, foot valves, steel, iron, frogs, switches, track bolts, revolving screens, etc., as per Circular No. 564.

The Davis Coal Mining Company is opening a new mine at Roundup, Mont. This is to be equipped with electric haulage system, pumps, lighting and mining machinery. Equipment will be purchased by the Sheriden Coal Company, of Dietz, Wyo., which controls the above company.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., March 7, for hoisting engine, capstans and engine, pumps, boring machine, steel castings, gear cutters, milling tools, twist drills, chain blocks, gages, oil cups, steel tapes, etc., as per Circular No. 561.

The Isthmian Canal Commission, Washington, D. C., wil receive bids up to 10:30 a.m., February 19, for copper, steel tubing, lock washers, steel cable, wire, screw eyes, screws, bolts, rivets, taps, twist drills, countersinks, blacksmiths' punches, chisels, files, etc., as per Circular No. 560.

The American District Steam Company, Lockport, N. Y., is making extensive additions to its plant at North Tonowanda. A two-story machine shop will be erected in which will also be installed testing room, pattern shop and carpenter shop. When construction is completed the entire plant will be moved to Tonawanda.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: March 1—Marine water-tube boilers (schedule 2257), hydraulic turbine-tube cleaners (schedule 2263), pumps and motors (schedule 2240), measuring tapes (schedule 2246), bolts and nuts, hardware and tools, locks, steel hull rivets, metal scrapers, hand tools (schedule 2261), calipers, twist drills, files, hammers, pliers, screw drivers (schedule 2249), round machine steel, galvanized sheet steel, vanadium steel (schedule 2247), dry graphite (schedule 2250), 18-inch screw-cutting lathe (schedule 2242).

Sealed proposals will be received by the Board of Fire and Water Commissioners, at their office in the City Hall, Kansas City, Mo., on March 10, 1910, for the manufacture and furnishing to the Water Department of Kansas City, Missouri, at the Turkey Creek Station, the following machinery: 1—36"x24' all geared head lathe with constant-speed motor drive. 1—20"x18' all-geared head lathe with constant-speed motor drive. 1—16"x12' all-geared head lathe with constant-speed motor drive. 1—36"x36"x12' planer with plain motor drive. 1—18" back-geared shaper with constant-speed motor drive. 1—Universal milling machine with constant-speed motor drive and working surface of table about 45"x10". 1—3' arm radial drill with back-geared tapping attachment, worm swiveled table and constant-speed motor drive and through-speed box. 1—Motor-driven emery stand. 1—Motor-driven 5"x5" hack saw. 1—Motor-driven 8" air fan for fire blast. 1—36" motor-driven hand saw. All in accordance with the specifications on file in the office of the superintendent of the water works, which bids will there be publicly opened and read. Each bid shall be accompanied by cash or a certified check amounting to five per cent. (5%) of the total bid; said check to be made payable to the city comptroller, as a guarantee that the bidder receiving the award will enter into contract and furnish security satisfactory to the city comptroller for the furnishing and delivery of the machinery named in the proposal. Each bid shall state the time in which the machinery will be furnished. The right is reserved to accept the lowest or any bid offered and to reject any or all bids, or to waive any irregularities or informalities in the bids, when it seems to be to the interest of Kansas City, Missouri, so to do.

NEW INCORPORATIONS

Waterville Iron Works, Waterville, Me. Conducting iron-working business. Capital, $50,000. Frank B. Philbrick, president.

E. E. Cutler Company, Portland, Me. Metal work of all kinds. Capital, $35,000. F. H. Forbes, president; F. E. Cutler, treasurer.

Lebanon Automobile Company, Lebanon, N. H. Garage and repair shop. Capital, $15,000. E. Bertram Pike, of Pike, N. H., president.

Pement Tool Works, Chicago, Ill. Manufacture tools and machinery. Capital, $30,000. Incorporators, H. C. Priebe, F. T. Winslow, L. L. Miller.

Marine Freezing Company, Camden, N. J. Cold-storage business. Capital, $75,000. Incorporators, F. R. Hansell, Geo. H. B. Martin, J. A. MacPeak.

Blakeslee-Britten Company, Jersey City, N. J. Manufacture automobiles, etc. Capital, $50,000. Incorporators, G. E. Blakeslee, E. G. Britten, E. E. Downs.

Labelle Gas Regulator Company, Lowell, Mass. Manufacture gas appliances. Capital, $100,000. Incorporators, A. J. Gagnon, F. N. Labelle, G. W. Pearson.

New Ulm Gas Company, New Ulm, Minn. Capital, $100,000. Incorporators, E. B. Southwick, E. A. Scherer, Cleveland, Ohio; H. M. Booth, Mentor, Ohio.

Columbia Machine and Wood Screw Company, Boston, Mass. Capital, $50,000. Incorporators, C. E. Hall, W. Medford, L. H. Dodge, S. W. Culver, Boston.

Marion Acetylene Specialty Company, Jersey City, N. J. Automobile parts. Capital, $25,000. Incorporators, E. Bournonville, C. Bournonville, A. Bournonville.

Louis J. Bergdoll Motor Company, Camden, N. J. Manufacture motor vehicles. Capital, $500,000. Incorporators, Louis J. Bergdoll, F. R. Hansell, J. A. MacPeak.

Central Automobile Company, Morgantown, W. Va. Manufacture automobiles. Capital, $10,000. Incorporators, Benj. M. Chaplin, C. Russell Huston, J. L. Smith, etc.

Fleischman Vehicle Company, New York. Manufacture carriages, automobiles, etc. Capital, $25,000. Incorporators, O. K. Fleischman, R. H. Fleischman, P. Damm.

Lincoln Manufacturing Company, Jersey City, N. J. Manufacture building material, etc. Capital, $1,000,000. Incorporators, T. A. McCarthy, R. F. Tully, W. F. Delaney.

Empire Electric and Manufacturing Company, Plainville, Conn. Manufacture electric fittings. Capital, $50,000. Incorporators, Bery Lamb, J. E. Lamb, H. E. Propson, etc.

Downer Place Automobile Company, Aurora, Ill. General automobile and garage business. Capital, $25,000. Incorporators, Chas. S. Battle, Irving Ochsenschlager, John L. Dickes.

New Taxicab and Motor Company, New York. Manufacture, deal in and repair motor vehicles. Capital, $25,000. Incorporators, G. H. Reaney, F. J. Manning, M. W. Cooper.

Peerless Water Softener Company, Indianapolis, Ind. Manufacture water-softening machinery. Capital, $25,000. Incorporators, H. B. Smith, W. A. Dodge, F. H. Dedert.

Innerness Mill Company, Winston, Salem, N. C. Manufacture cotton cloth. Capital, $150,000. J. B. Duke and W. W. Fuller, of the American Tobacco Company, are stockholders.

The Klemp-Simson Company, Chicago, Ill. General engineering, contracting and foundry business. Capital, $25,000. Incorporators, Wm. F. Klemp, Harry P. Caswell, John C. Mathews.

The Autoreviseur Company, Camden, N. J. Manufacture autoreviseur machines, printing, engraving, etc. Capital, $150,000. Incorporators, C. K. Stokes, L. MacFarland, J. A. MacPeak.

Titan Steel Casting Company, Newark, N. J. Conduct general iron and steel business. Capital, $1,000,000. Incorporators, Corwin Howell, Waldron M. Ward, Newark; John H. Conover, Orange.

Sanitary Telephone Transmitter Company, New York. Manufacture and deal in telephones and electrical apparatus. Capital, $100,000. Incorporators, J. Tatlock, A. L. Clark, H. A. Crosby.

Harold L. Bond Company, New York. Manufacture and deal in machinery and railroad supplies. Capital, $25,000. Incorporators, H. L. Bond, Malden, Mass. G. S. Hedge, Wellesley, Mass.; H. O. Weaver, New York.

Fenn Needle and Manufacturing Company, Hartford, Conn. Manufacture knitting needles for mills and machinery for making same, invented by A. G. Fenn, of Chicopee, Mass., one of the incorporators. Capital, $1,000,000.

United Track and Wheel Brake Company, New York. Manufacture brakes and other railway appliances. Capital, $1,000,000. Incorporators, M. B. Bloomer, Westfield, N. J.; C. E. Smith, Sheepshead Bay, New York, etc.

General Plumbers Supply Company, Jersey City, N. J. Manufacture plumbing and sanitary fixtures and supplies. Capital, $50,000. Incorporators, J. Kennedy, Jersey City; S. Grossman, Brooklyn, N. Y.; J. Jordan, Bronx, N. Y.

Packers Motor Truck Company, of Pittsburg, Penn. Manufacture motor trucks, automobiles, supplies, aëroplanes. Capital, $100,000. Incorporators, A. M. Schenck, Wheeling, W. Va. Wm. Zellar, E. K. Callahan, Pittsburg, etc.

Delaware Structural Steel Company, New York. Manufacture and deal in structural steel and iron work, construct bridges, etc. Capital, $250,000. Incorporators, W. S. Thorp, W. E. Millow, New York; L. M. Parsons, Derby, Conn.

The Gila River Power Company, Santa Fe, N. M. Capital, $6,000,000. Incorporators: Thomas Lyons Gila; Wm. D. Murray, Silver City; John R. Bartlett, 2 Wall street, New York. Headquarters are Silver City, Grant county, N. M.

MacWilliam Automobile Company, New York. Manufacture and deal in motors, engines, motor cars, etc. Capital, $10,000. Incorporators, A. F. MacWilliam, 1985 Broadway, J. F. MacWilliam, 246 West Sixty-fifth street, New York, etc.

BUSINESS ITEMS

The Williamsport (Penn.) Gas Engine Works have reopened the plant of the Williamsport Gas Engine Company, which has been shut down during the past year, and will continue the entire line of gas and gasolene engines formerly manufactured by the old company.

The Risdon Tool and Machine Company, Incorporated, Waterbury, Conn., has been incorporated under the Connecticut laws, and will take over the business of the Risdon Tool Works of that city. The new company has largely increased its facilities and added new lines. It will design and make plain dies, and a specialty of subpress dies, manufacturing the sheet-metal novelties of all kinds from these dies if desired. They will also make models and build light machinery and parts on contract. The officers of the new corporation are W. L. Shepard, president, superintendent American Mill's Company, Waterbury, Conn.; A. H. Dayton, vice-president, cashier Naugatuck National Bank, Naugatuck, Conn.; G. T. Wigmore, secretary and treasurer, assistant cashier National Bank, Naugatuck, Conn., and the directors are Matthew Adgate, superintendent Naugatuck Chemical Company, Naugatuck, Conn.; C. T. McCarthy, secretary Goodyear's M. R. Shoe Company; C. E. Beardsley, auditor, Waterbury Brass Company, Waterbury, Conn.; C. W. Andrews, real estate, Naugatuck, Conn.; W. J. Neary, lawyear and real estate, Naugatuck, Conn.; W. L. Shepard, G. T. Wigmore.

TRADE CATALOGS

E. M. Dart Manufacturing Company, Providence, R. I. Folder showing unions and flanges. Illustrated.

The Chandler Company, Springfield, Mass. Catalog of name plates and stampings. Illustrated, 4x9 inches, paper.

Rockford Machine Tool Company, Rockford, Ill. Loose-leaf catalog of crank shapers and planers. Illustrated, 9x11½ inches.

The Cushman Chuck Company, Hartford, Conn. Catalog of chucks and faceplate jaws. Illustrated, 44 pages, 4x7 inches, paper.

The Wright Wrench Manufacturing Company, Canton, Ohio. Booklet describing Wright wrench. Illustrated, 3½x6 inches.

The Cutler-Hammer Manufacturing Company, Milwaukee, Wis. Booklet describing elevator controllers. Illustrated, 128 pages, 5x8 inches, paper.

Foote Brothers Gear and Machine Company, 214 North Carpenter street, Chicago, Ill. Catalog of gears, racks, sprockets. Illustrated, 104 pages, 4½x6½ inches, paper.

Hoefer Manufacturing Company, Freeport, Ill. Catalog P, describing drill presses, power metal saws, drilling and boring machines. Illustrated, 56 pages, 6x9 inches, paper.

J. T. Slocomb Company, Providence, R. I. "The Measuring Book" with suggestions in regard to accurate and economical measuring in machine construction. Illustrated, 32 pages, 3x9 inches.

McGraw-Hill Book Company, 239 West Thirty-ninth street, New York. Catalog of books in three parts—Part I, Electrical Books, Part II, Mining and Metallurgy, Part III, Engineering, Civil, Mechanical, Power.

International Steam Pump Company, 115 Broadway, New York. Bulletin W 175 describing Worthington turbine pumps for high-head service. Illustrated, 32 pages, 6x9 inches. Bulletin W 176, describing Type D centrifugal pumps for low-head service. Illustrated, 12 pages, 6x9 inches.

WANT ADVERTISEMENTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—An experienced salesman for steam pumps, boilers, etc.; a good job for the right man; state experience and salary expected. Box 206, AMERICAN MACHINIST.

CONNECTICUT

Experienced jig and gage designers wanted; steady employment promised. Box 245, AM. M.

Wanted—Foreman of department in a large New England machine shop; must be a specialist in building machinery by modern methods; this department builds one type of machine only and the acceptable man must be competent to attain maximum results; shop equipment is first class and position permanent to right man; accepted applicant will be required to show his fitness by his past record and replies will be treated confidentially. State salary expected. Box 185, AMERICAN MACHINIST.

DELAWARE

Wanted—A-1 mechanic between 35 and 40 years of age, who has had wide experience in the manufacture of fire arms; must be a practical toolmaker and designer of jigs, fixtures and special machinery for the rapid and accurate production of interchangeable parts; must also possess executive ability and know how to handle help and material; in replying to this advertisement give age, experience and salary expected; otherwise no attention will be paid to the application. Box 210, AMERICAN MACHINIST.

ILLINOIS

Wanted—Foreman for blacksmith shop, manufacturing implements; must be sober and capable man and a hustler who can produce results with our present equipment; give references and state salary expected in first letter. Box 211, AMERICAN MACHINIST.

Wanted—Cost accountant, with experience and ability to handle all cost records for a factory employing 500 hands; only applicants will be considered who have actually had charge of determining factory burdens and expense distributions; permanent position with excellent prospects; modern plant; state age, nationality and salary expected. Box 250, AMERICAN MACHINIST.

MARYLAND

Wanted—Experienced designers on marine engines; give character of experience and salary desired. Address Ellicott Machine Company, Baltimore, Md.

MASSACHUSETTS

Wanted—Operator for Brown & Sharpe and Pratt & Whitney automatic screw machines; good pay and steady employment to the right man; preference given to man able to do camming. Box 226, AMERICAN MACHINIST.

First-class mechanical draftsman and designer, preferably with high-speed steam engine experience, wanted for permanent position in large manufacturing concern in Massachusetts; state age, education, experience and salary expected, by addressing "M. W. A.," Box 243, AMERICAN MACHINIST.

Wanted—Small, well established manufactory wants a competent mechanical man to take charge as superintendent; to one familiar with automatic screw machines, foot and power presses, also second operation work and with some experience in tool making, this is an exceptional opportunity; state age, experience and salary. Box 225, AM. MA.

Wanted—Cost accountant; good executive, familiar with uptodate methods and competent to take entire charge of time keeping, cost records, expense distributions, determining factory burdens and stock keeping; high grade, uptodate factory; good location, excellent opportunity; none but first-class men with experience need apply; state salary wanted and give references; correspondence confidential. Box 249, AMERICAN MACHINIST.

We are increasing our force and invite applications from experienced iron and brass moulders, core makers, chippers, pattern makers, draftsmen, production men, machine tool operators (all kinds), brass finishers, polishers, layout men, bench hands, erectors, etc. Heavy and light engine and pump manufacture; works handy to Boston and best evening schools; no labor trouble, and applicants are notified as soon as positions are open; applicants should state age, height, weight and experience in detail. Address Employment Division, Blake & Knowles Steam Pump Works, East Cambridge, Mass.

MICHIGAN

Wanted—Experienced gunbarrel and gun frame bluer. Please state experience, rate of wages expected, etc. Box 3, AMER. MACH.

Wanted—Twenty-five first-class experienced tool and automobile draftsmen; state age, experience, salary wanted, reference, etc. Buick Motor Co., Flint, Mich.

Wanted—Competent and experienced foreman for drawing room with 20 to 25 draftsmen; permanent position and good salary to right man; state experience, age, salary, references and full information. Box 204, AM. M.

Gasolene engine factory in southern Michigan requires more toolmakers, patternmakers and draftsmen on engine and tool and fixture work; applications from first-class men should state age, experience and wages required. Holms Machine Mfg. Co., Sparta, Mich.

MISSOURI

Foreman Wanted—An experienced man capable of taking charge of 100 men who thoroughly understands the manufacture of woodworking machinery. Address giving experience, nationality, age, reference and salary. Box 208, AMERICAN MACHINIST.

NEW JERSEY

Man to take charge of tool room; state experience and wages expected. Ferracute Machine Company, Bridgeton, New Jersey.

Wanted—Draftsmen familiar with machine tool work; give references and salary expected. Box 215, AMERICAN MACHINIST.

Wanted—Draftsmen familiar with heavy turret lathe work; give references and salary expected. Box 216, AMERICAN MACHINIST.

Wanted—In Newark, N. J., middle-aged intelligent American accustomed to hardening and tempering steel; steady occupation, good pay. Address stating experience, National Lock Washer Co., Newark, N. J.

Wanted—Toolmakers conversant with fine subpress die work for small duplicate parts; only men of ability on this class of work need answer; factory located within 40 minutes of New York. Box 193, AMER. MACH.

NEW YORK

Wanted—Expert toolmakers on punches and dies; good wages and superior shop. Apply Bates Machine Co., 704 Jamaica Ave., Brooklyn, N. Y.

Wanted—First-class toolmakers, experienced on jig, fixture, watch tool and precision work. Apply Mergenthaler Linotype Co., 24 Ryerson St., Brooklyn, N. Y.

Wanted—First-class automatic screw machine hands; none but experienced parties need apply. Mergenthaler Linotype Company, 20 Ryerson St., Brooklyn, N. Y.

Draftsmen and toolmakers wanted, experienced on tool, jig and fixture work; state age, experience in detail and rate expected. Remington Arms Company, Ilion, N. Y.

Draftsmen wanted on automatic machinery; only first-class men with practical experience need apply. American Machine and Foundry Co., 346 Carroll St., Brooklyn.

Wanted—Automobile manufacturer is in need of several first-class draftsmen; give account of experience, where employed, age, salary and earliest date you could report for work. Box 205, AMERICAN MACHINIST.

Draftsman wanted, capable of designing detailed parts of automatic machines and making complete set of working drawings from general designs furnished; must be accurate at figures. Box 235, AMERICAN MACH.

Wanted—By large manufacturing concern in central New York, man familiar with steam and electrical power plants, millwright work, piping, etc.; also general plant up-keep; must be a good executive and able to lay out and supervise work in master mechanic's department when required; give experience, age and salary expected. Box 217, AM. MA.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable charcters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

OHIO

Wanted—A gas engine engineer, who is familiar with gas producers and tandem gas engines. Box 240, AMERICAN MACHINIST.

Wanted—One or two first-class diemakers to act as foremen; those having had experience in laying out work given preference; steady employment; good wages. Box 174, AMERICAN MACHINIST.

Wanted—A strictly high-grade factory manager for a successful and growing concern employing six hundred men manufacturing automobile parts; must have wide experience and exceptional executive ability; we want a strictly high class factory manager with a successful record as such; salary accordingly. Box 220, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Draftsmen accustomed to machine tool design. Address with references, National Tube Company, Engineering Department, McKeesport, Penn.

Patternmaker who can take charge wanted for foreman in a pattern shop connected with a manufacturing plant in eastern Pennsylvania; state age and give full particulars with experience, etc. Address Irvin Bair, 116 North Broad street, Philadelphia.